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MACHINE DESIGN

as it affects ENGINEERING • PRODUCTION • SALES

PARTS MATERIALS METHODS FINISHES

OF MACHINES OF EVERY SIZE AND TYPE

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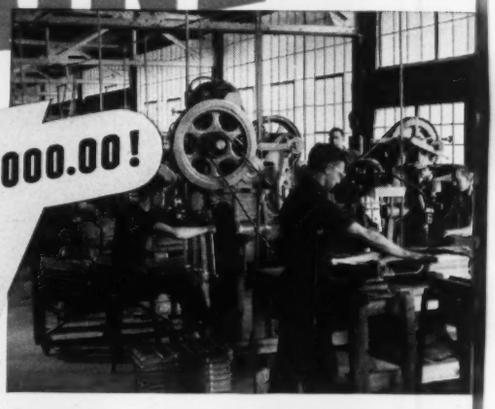

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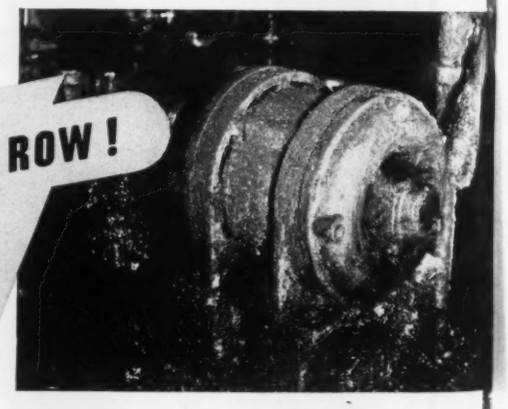

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To get this kind of performance . . . and to assure yourself complete customer satisfaction — it will pay you to get the Allis-Chalmers Lo-Maintenance Motor story.

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MACHINE DESIGN

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

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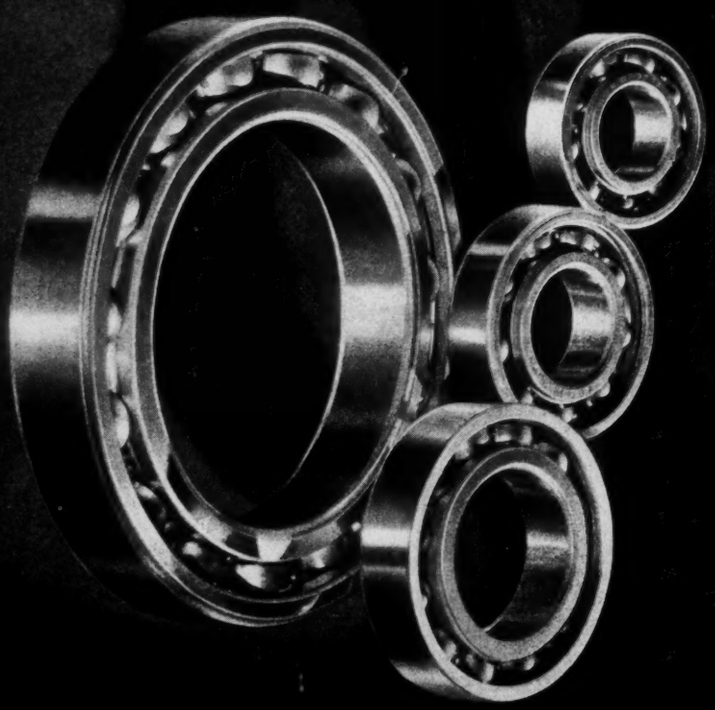


NEW DEPARTURE

THE FORGED STEEL BEARING

MACHINE
DESIGN

Induction Hardening Offers Design Economies

By Fred B. Jacobs

ECONOMY in design is facilitated by induction hardening from the point of view of wide latitude in the selection of materials as well as ability to control and limit the areas of hardness, regardless of size. Because the process involves a closely controlled cycle of high-frequency current and water quench around the area treated, it is possible to harden any portion of a machine part without distortion or variations in surface hardness. A typical machine for induction hardening is shown in *Fig.* 1.

With high frequency current flowing through a solenoid about the treated part, the rapid reversals in induced magnetism cause the molecules in the steel to move with great rapidity in striving to adjust themselves to the current polarity. Intermolecular friction caused by this movement creates the heat required in the hardening process. Only the molecules near the surface, however, are thus affected. Those at the core are at rest and therefore no heat is generated. When steel is treated in this way and

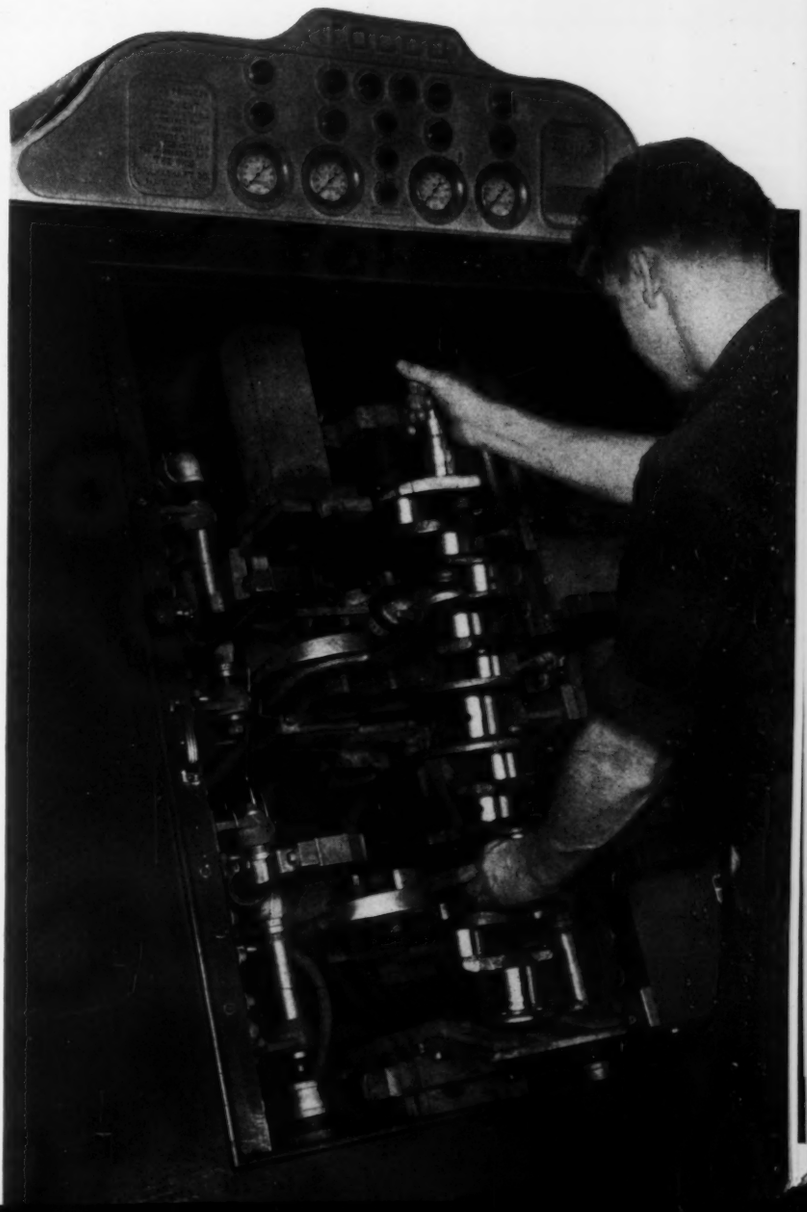


Fig. 1—Induction hardening unit for hardening crankshaft bearing surfaces

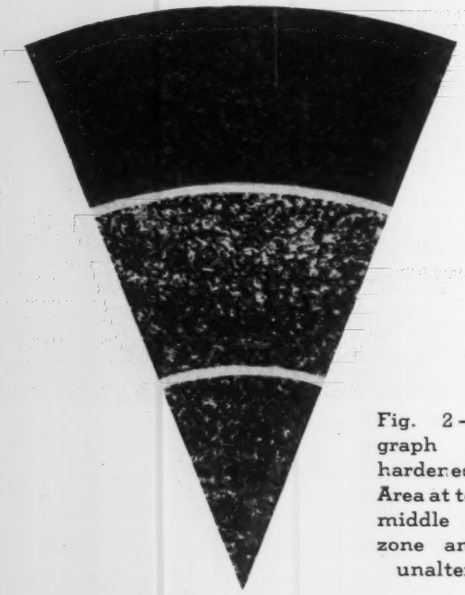


Fig. 2 — Photomicrograph of surface-hardened steel forging. Area at top is hardened, middle is transition zone and bottom is unaltered soft core

suddenly quenched the surface only is hardened, the core remaining in its original soft state without affecting its toughness.

No sharp division results between hardened case and core. Surface hardness extends through 80 per cent of its depth. Thence it decreases gradually through a transition zone to the soft core where the steel structure has not been altered by the process. This gradual reduction of hardness is illustrated in the photomicrograph, *Fig.* 2, of a forging enlarged 50 diameters. Below the hardened surface is seen the gradation zone where the hardness gradually decreases to the unaltered core.

Treatment Determines Properties

This part is SAE 1050 steel with residual chrome. Its chemical analysis is .53 carbon, .9 manganese, .016 phosphorus, .026 sulphur and .27 per cent chromium. Physical properties are: Elastic limit 57,750 pounds per square inch; ultimate strength 102,000 pounds per square inch; reduction in area 47.5 per cent; elongation in 2 inches 22 per cent; brinell hardness 207; Izod impact 30 pounds; Rockwell C on surface 56 min.; McQuaid-Ehn grain size 6-8. Previous treatment is not normalizing but consists of a fast air cool from above the critical point. The temperature to which the steel is heated and the rate of cooling determine the hardness and physical properties of the forging before induction hardening. Hardness distribution of this part is shown graphically in *Fig.* 3. If greater penetration is desired the heating cycle is lengthened. Typical cycles are only a matter of 4 or 5 seconds.

In selecting a steel for hardening there are many

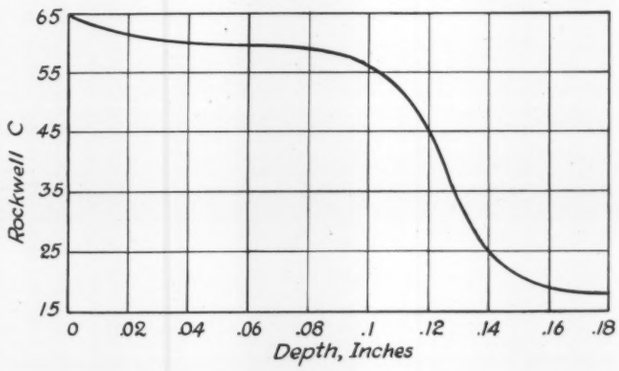


Fig. 3—Hardness distribution through hardened area

requirements to be considered. Carbon content must be sufficient to produce the desired hardness when the part is quenched. However, the induction method is productive of a greater degree of hardness than is possible through the use of other methods. Fine-grain steel is to be preferred but is not always essential. In hardening parts which are subject to considerable strains it has been found advisable to use a heat treated structure which is predominantly sorbitic or a normalized structure having a grain size comparable to the heat treated. Experiments along practical lines have demonstrated that low-carbon steels with a carburized medium and high carbon steels both regular and alloy, and pearlitic malleable

Chemical Analyses of Some Typical Induction Hardenable Steels

Type	Carbon	Mn.	P (max.)	S (max.)	Ni.	Cr.	Mo.	Si. (max.)	W	V
S.A.E. 1035-1090	.3 / .95	.6 / .9	.04	.05	.....	.....	.....	.03	...	...
S.A.E. 1050 Mod.	.45 / .55	.7 /1.05	.04	.05	.....	.30 max.	.....	.03	...	...
S.A.E. T1340-45.	.35 / .5	1.6 /1.9	.04	.05	.....	.....	.....	.03	...	...
Mola	.588	1.16	.014	.015	Nil.	.21	.15	...	...	...
S.A.E. X4340 ..	.35 / .45	.5 / .8	.04	.04	1.25/1.75	.7 / .09	.15/.25	.03	...	...
S.A.E. 4140	.35 / .45	.5 / .8	.04	.04	.....	.8 / 1.1	.15/.25	...	...	...
S.A.E. X3140-50.	.35 / .55	.6 / .9	.04	.04	1.1 /1.5	.7 / .9	.....	...	...	...
Foreign	.382	.38	.011	.021	2.74	.88	.....	...	...	...
Foreign	.32 / .38	.3 / .5	.02	.03	2.5 /3.	.8 / 1.	.....	...	...	...
Foreign	.294	.25	.008	.008	3.91	1.07	.51	...	...	...
Foreign	.35	.63	.008	.009	.65	1.06	.95	...	...	...
Foreign	.516	.59	.018	.037	.96	Nil.	Nil.	...	...	...
Foreign	.376	.71	.029	.039	.08	.33	Nil.	...	...	...
S.A.E. 52100 ...	.95 /1.1	.2 / .5	.03	.035	.....	1.2 / 1.5	.....	...	...	...
420 Stainless ..	over .12	.....	...	...	.....	12. /14.	.....	...	...	...
M17 Stainless ..	.67	.....	...	...	.....	16.58	.....	...	...	...
Malleable Iron.	2.5	.93	.17	.095	.....	.....	.....	.94	...	...
Graphitic Steel.	1.5	.4	.015	.02	.....	.....	.....	.8	...	...
18-4-1	.7	.....	...	...	.....	.....	.....	...	18.	1.

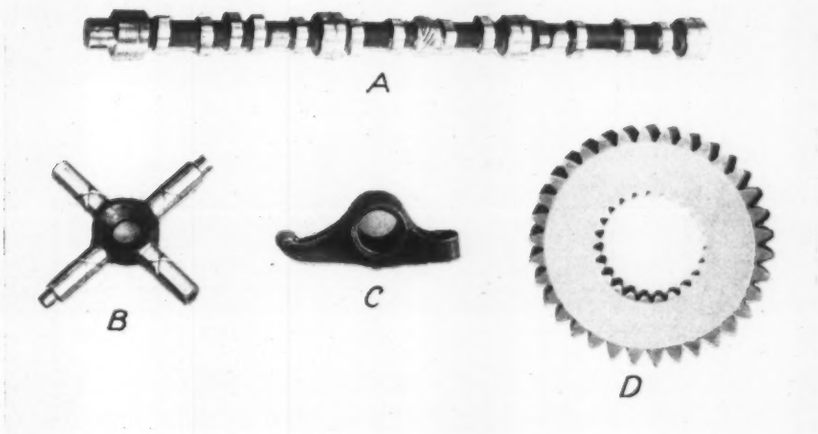


Fig. 4—Typical small parts where surface hardening is ideal. At **A** is camshaft with hardened cam surfaces; B, differential gear spider with soft hub and hardened arms; C, valve rocker with a hardened tip and D, gear with both external and internal teeth hardened

cast iron can be hardened successfully through use of the induction process. The accompanying table, compiled by the Ohio Crankshaft engineers, lists the chemical analyses of typical induction hardenable steels.

By the induction hardening process it is possible to specify exactly what sections of a given machine part should be hard and which should remain soft. A practical example is the internal combustion engine camshaft shown in *Fig.* 4a. Only cam and bearing surfaces need be hardened. One method previously used was to caseharden the entire shaft. However, this possessed a decided disadvantage because the comparatively slender shaft sprung out of alignment when quenched. To overcome this difficulty, sections between previously machined cams were ground to remove scale and copper plated. Then the parts to be hardened were ground to remove the plating. The desired result was attained, of course, but at a comparatively high expense. With induction hardening the process is simplified, cam and bearing surfaces being hardened, leaving the remainder soft.

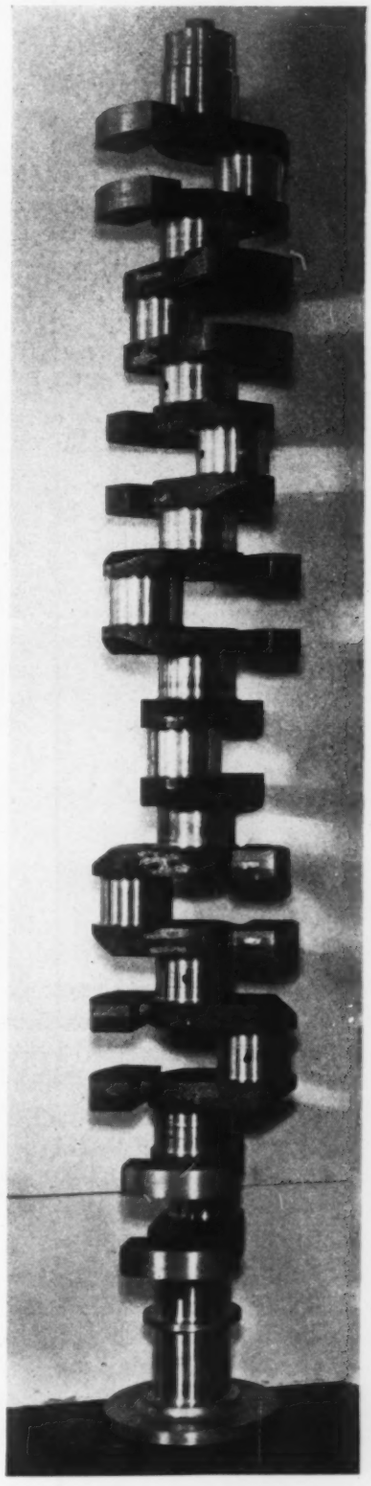
Eliminates Distortion Problems

In *Fig.* 4b is a differential gear spider. The four arms which carry the compensating gears are surface hardened while the center or hub is soft. If the entire part were hardened it might be distorted so that an excessive grinding allowance would be necessary to finish the arms.

It is as easy to harden internal surfaces with the induction method as it is to treat exterior surfaces. This is accomplished by passing the part over or around instead of through a solenoid. This feature is of value, not only for hardening comparatively small parts but hollow parts a foot long or over. Sometimes a part is hardened internally as well as externally, *Fig.* 4b. Teeth of this gear are hardened as are also the projections about the center hole. Large parts are hardened successfully as shown in *Fig.* 5 which is a crankshaft for a diesel engine used for streamlined trains.

Apart from the surface hardening of various steels there are other applications of induction hardening which should be given consideration. Among them might be cited the possibility of hardening a piece of steel and brazing it to copper or other metals simultaneously. Again, it is possible to draw the temper of a section of a piece previously hardened so that the section is machinable through the use of ordinary cutting tools. Induction hardening also makes possible a reduction in the number of parts in a given assembly. For example, in the design of automobile axles it often is the procedure to locate a hardened bearing member on the shaft. Through the application of this process the designer simply specifies what parts of the shaft should be hardened, obviating the extra part.

Fig. 5—Massive diesel crankshaft with hardened pins and main bearings

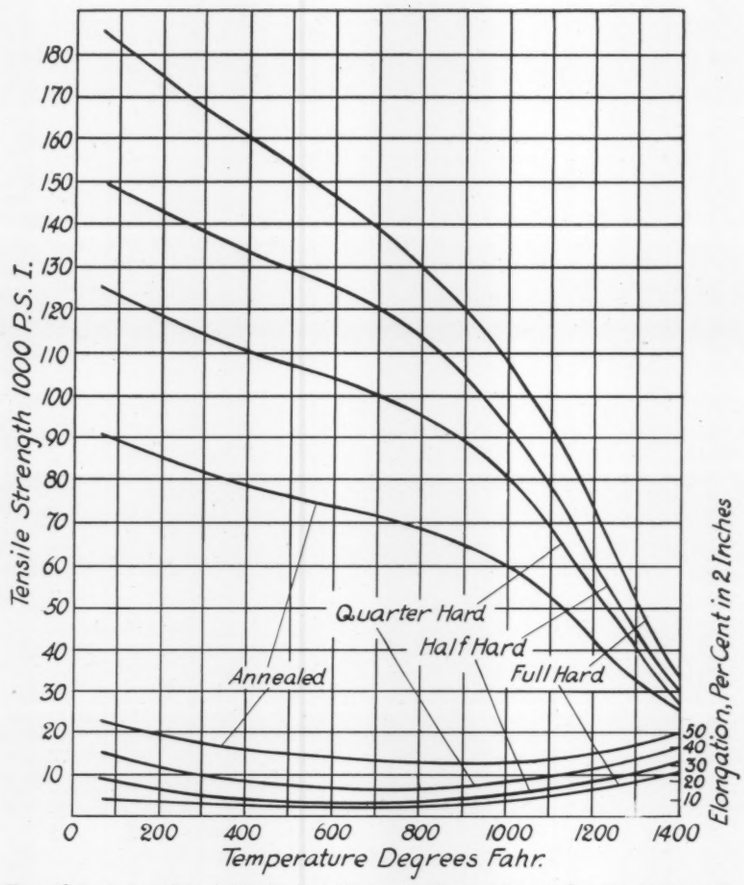


Stainless Retains Strength at High Temperatures

By H. V. Thaden
Carnegie-Illinois Steel Corp.

WHEN extreme conditions of temperatures prevail as a result of accident, emergency or other conditions, it is desirable to know what the materials in use will withstand effectively. One such condition is in the aviation industry in handling high temperature exhaust gases. These usually run from 1200 to 1500 or 1600 degrees Fahr. If, by chance, they should leave the conduits or paths through which they were designed to flow and impinge upon adjacent material, serious consequences might arise.

To determine just what would happen in the case of a structure built of 18-8 stainless steel were it to be subjected to such temperatures, a test was made, the results of which are shown in the curves. In this test each of the various grades of full hard (185,000 pounds per square inch ultimate tensile strength), one-half hard (150,000 p.s.i.), one-quarter hard (125,000 p.s.i.) and annealed (90,000 p.s.i.) stainless steel was subjected for a period of one-half hour to various temperatures ranging from room temperature to 1400 degrees Fahr. While still at this temperature the specimens were loaded and the unit stresses and elongations were determined.



Tensile strength of 18-8 stainless steel at elevated temperatures. Specimens were held at indicated temperatures for one-half hour

The significance of these results is not difficult to appreciate, especially when it is noted that a piece of full hard stainless steel when subjected to a temperature of 1000 degrees Fahr. (red hot) for a time in excess of one-half hour, still retained a strength of over 100,000 pounds per square inch. Even at 1300 degrees Fahr., a temperature that could be anticipated either in "normal" engine operation or in the case of accidental fire—the full hard specimen of stainless steel still showed a tensile strength of 50,000 pounds per square inch. Another noteworthy point observed is that stainless withstands temperatures up to 1650 degrees Fahr. without scaling.

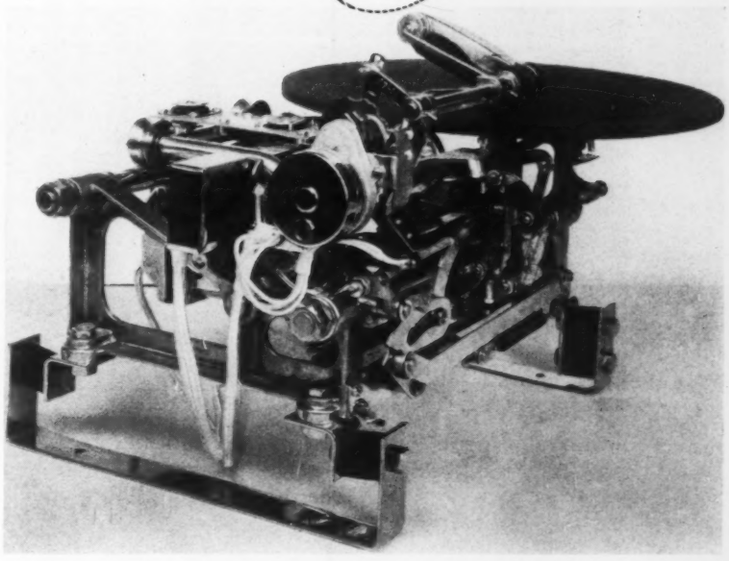
These results as stated were obtained after the test specimens had been held at the given elevated temperatures for one-half hour and are, therefore, not indicative of the creep strength, that is, their physical characteristics after prolonged subjection to elevated temperatures. However, in another set of experiments on the same type of material, in the lower tempers up to one-half hard, it was found that these specimens subjected to equal elevated temperatures for an entire week, 168 hours, showed no appreciable difference in the resulting tensile strengths.

While these tests were made primarily for the aviation application, the results may be translated to advantage in other fields of structural design. Wherever machine or structural parts or members must retain high strength at elevated temperatures or wherever they must resist scaling and corrosion at high temperatures, stainless steel may well be the answer. In fact, there are countless industries and places where consideration may well be given to stainless steel for heat resisting as well as corrosion resisting applications.

Scanning the Field FOR IDEAS

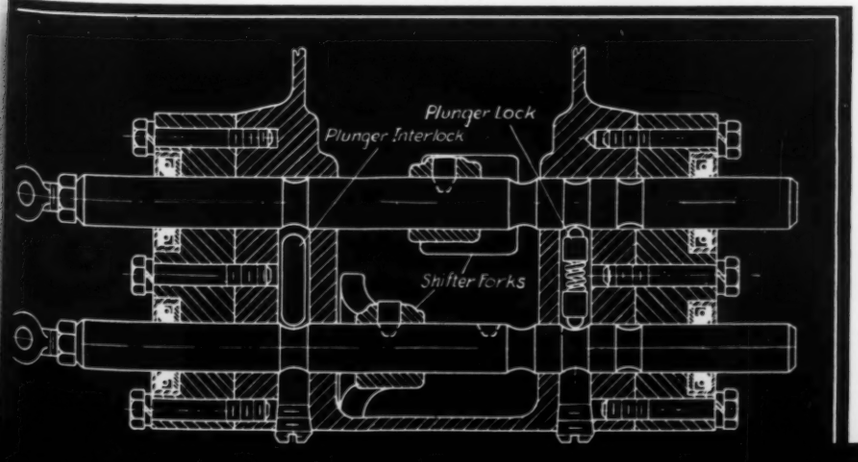
Rubber held in shear to dampen vibration finds many practical applications throughout industry from heavy equipment to delicate mechanisms. In the machine illustrated, high fidelity of music reproduction is aided in this way by isolating vibrations emanating from the drive or other extraneous sources.

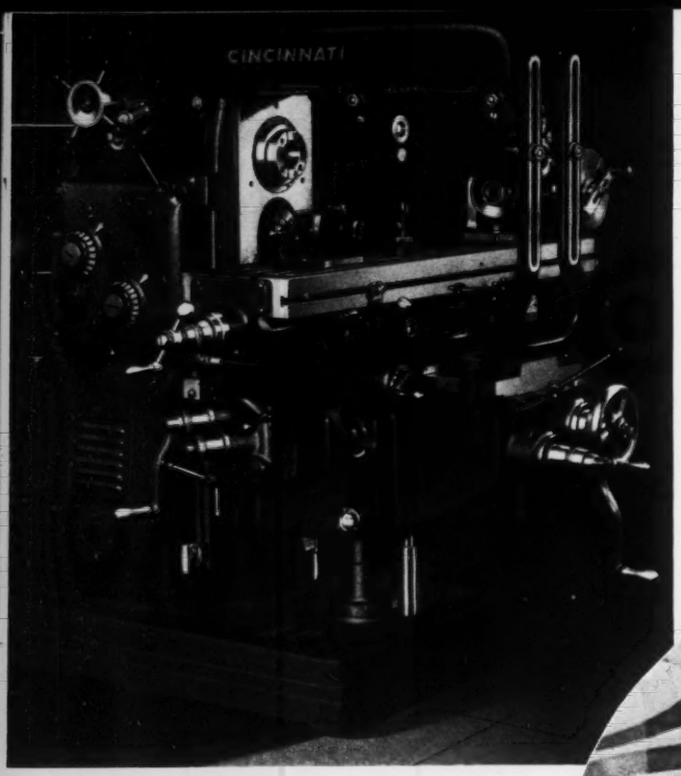
Often applied without any major redesign, these Vibro-insulators are mounted on brackets at each corner to eliminate mechanical noise which might emanate from the machine itself. Also, transmission of vibrations which might come through the floor are prevented. Thus the clarity of the record's musical note is maintained in this "penny phone" designed by the Cinematone Corp., Los Angeles



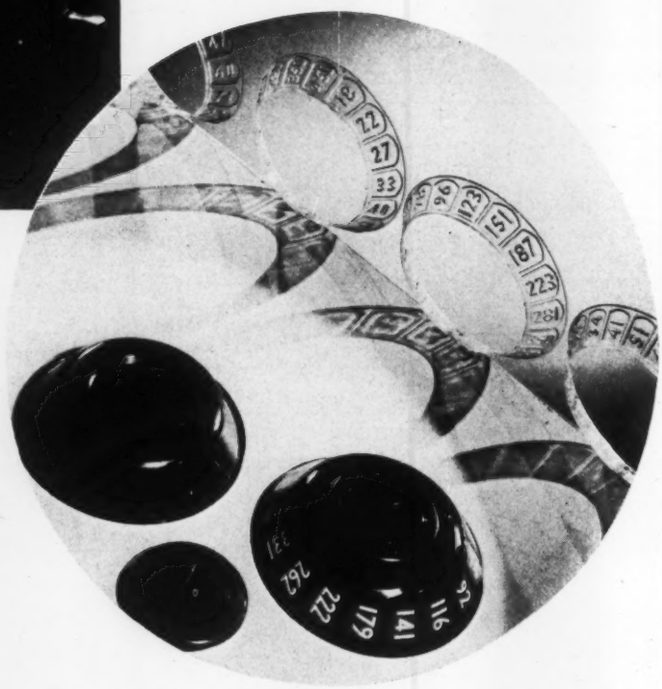
Mechanical interlock utilizes a single pin between grooves in gear shifter shafts to preclude the possibility of the reverse gears meshing while forward gears are in operation. Because the shafts are independently controlled by push-pull flexible shafting or hand levers an interlocking feature within the gear unit is necessary.

As shown in the illustration, the length of the pin is such that it must be in the recess of a groove in one of the shafts before the other can be shifted. Designed by the Detroit Harvester Corp. for power take-offs for use with auxiliary truck equipment ranging from dump body hoists to transit concrete mixers

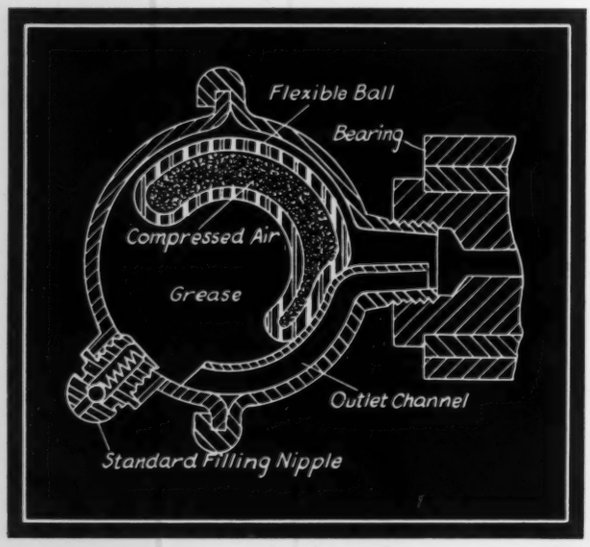




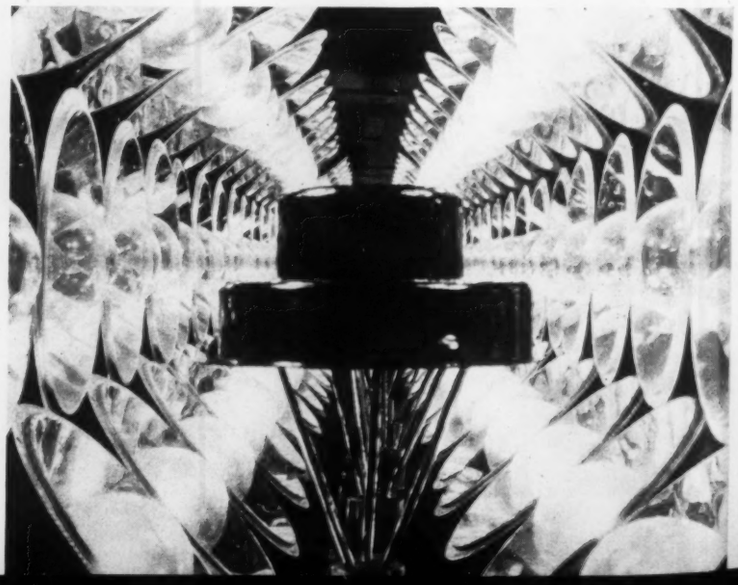
Plastic dials with sharp legible graduations add to the appearance and utility of this Cincinnati milling machine. Universal adaptation is achieved by casting a separate ring of clear Tenite for each range of settings. These rings, designed by J. E. Baxter, are under enameled in contrasting white, maroon and black and are snapped into place on a common base of black plastic. Serrations matching the fittings of the machine are cast into the base of the dial. Buttons of deep red Bakelite thread into and conceal recess at top of dial

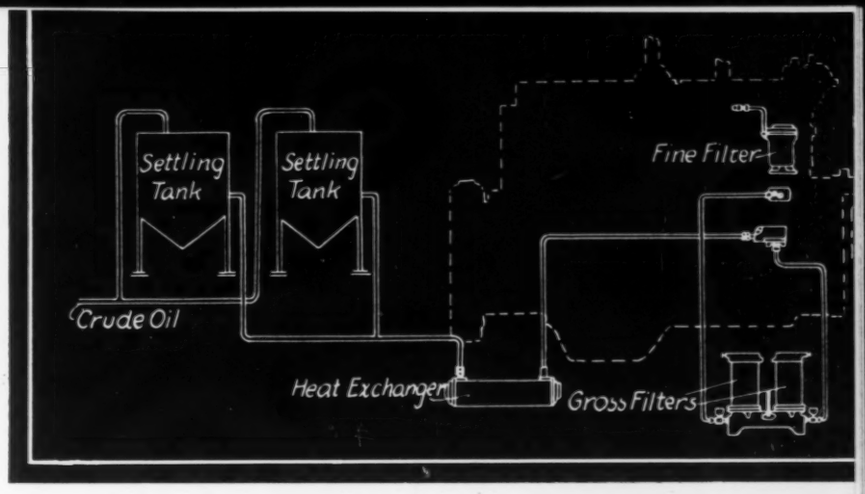


Flexible ball of neoprene in bearing lubricator provides a continuous flow of lubricant by pressure exerted by the compressed air retained in the ball. Consisting of a steel shell with fittings as shown and the enclosed ball and baffle to allow grease to enter bearing from any direction, this design of the Simplex Mfg. Co., Detroit, supplies enough lubricant under pressure to provide positive lubrication to the usual automobile chassis bearing during 5,000 miles operation. Static back pressure builds up to balance feeding pressure so that lubrication is supplied to bearing only when in operation



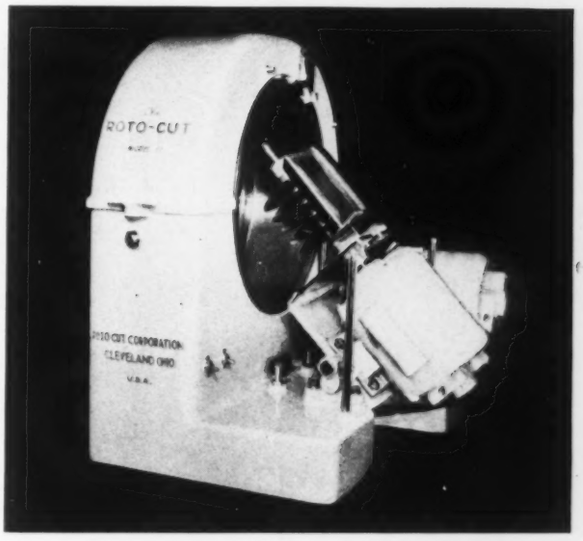
Directed infrared radiation bakes synthetic enamel on the parts being conveyed through this lamp tunnel. Using 216 GE drying lamps, 54 kilowatts, parts pass in five minutes to completely bake the black enamel surface. Neat, clean, flexible, economical, the tunnel uses gold plated reflectors, 9 inches in diameter. Drying by radiant energy in which the lamps operate at high temperatures developing infrared wavelengths produces high penetration





Corrosion resisting steel for injection equipment together with a unitized cleaning system make this Caterpillar diesel suitable for burning crude oil. Settling tanks, each with a 48-hour capacity, lessen the filtering required by the gross filters. Consisting of two compartments approximately 18 inches high by 8 inches in diameter, these filters remove the major amount of remaining dirt and abrasives and in turn reduce the load on the fine filter. Pressure gages on each side of the filters indicate their condition of operation. Base of the gross filters serves as a manifold. Performance curves for regular diesel fuel also apply to crude oil burning engines.

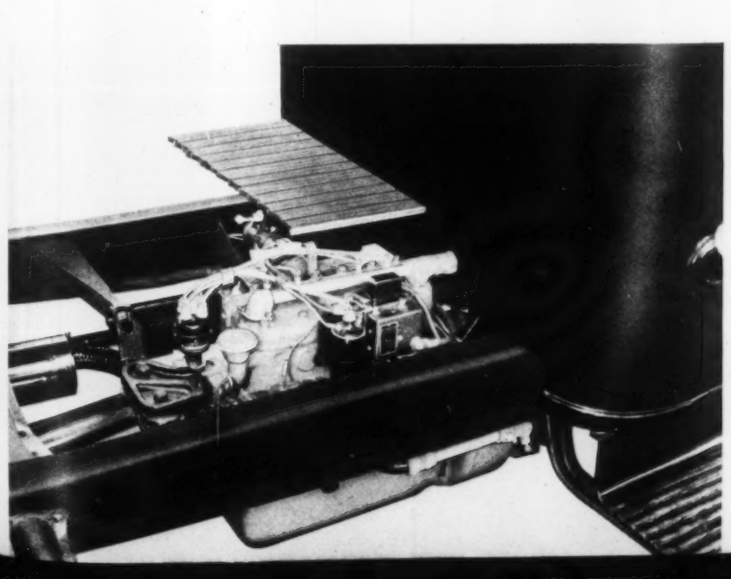
Like the standard diesel fuel system, it has no operating adjustment. Satisfactory combustion, however, is provided throughout the entire range of the engine



Revolving drum and knives provide centrifugal action for clean cutting of materials without crushing forces in this meat and vegetable cutting machine designed by Roto-Cut Corp. Material to be cut is evenly distributed about the drum and carried repeatedly under a series of knives to produce "draw-cut" operation. Mixer bar, closely fitting the cylinder, blends material, amount of time in machine determining fineness of cut.

Cylinder is highly polished nickel chromium alloy; knives, spacers shaft and other parts are rust proofed. Knives and cylinder are each individually driven by a 1/6 and 1/3 horsepower motor, respectively

Booster motor automatically starts when greater power is needed for quick starts and economical high-speed performance on hills. Designed by the Clark Equipment Co. the unit delivers its output to the rear axle by a simple and sturdy overrunning clutch and is mounted on rubber insulated brackets between chassis members so as not to interfere with loading capacity of truck.



Being subservient to the main engine at all times, the booster requires no attention from the driver. Control comprises a speed governor, a vacuum governor, an accelerator governor and an automatic throttle control. These interrelated units work together to start, control and stop the engine and assure a smooth, positive flow of power when required.

Each phase of the booster's operation is automatic and instantaneous, allowing the operator to accelerate rapidly through the gear changes or maintain speeds up to the capacity of the unit

How Holes and Flat Springs

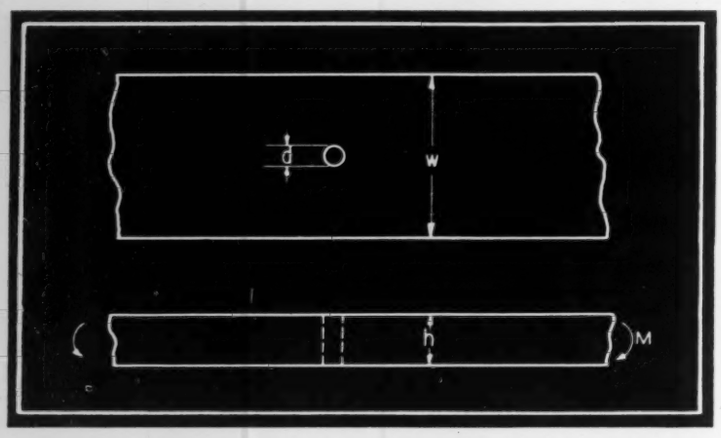


Fig. 1—Strip with hole under bending. Hole diameter is small compared to strip thickness. Upper curve of Fig. 2 may be used for theoretical stress concentration factor

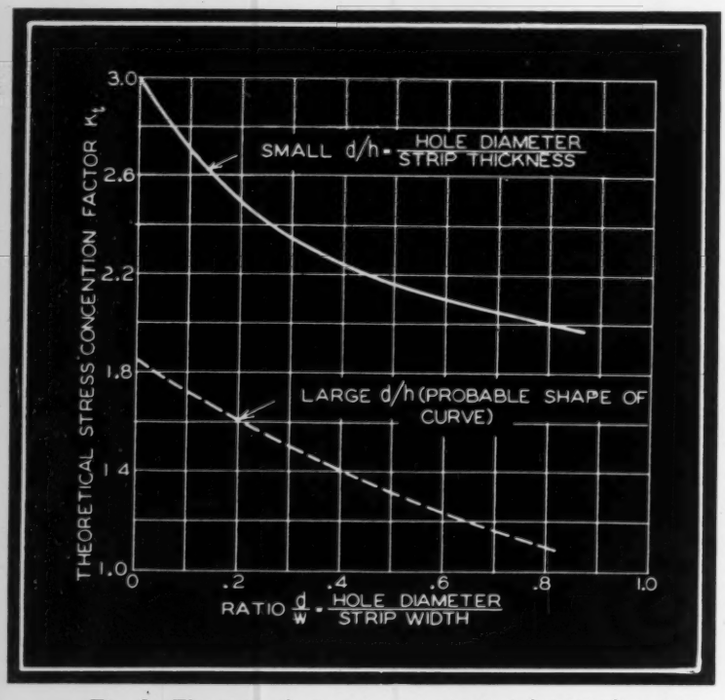
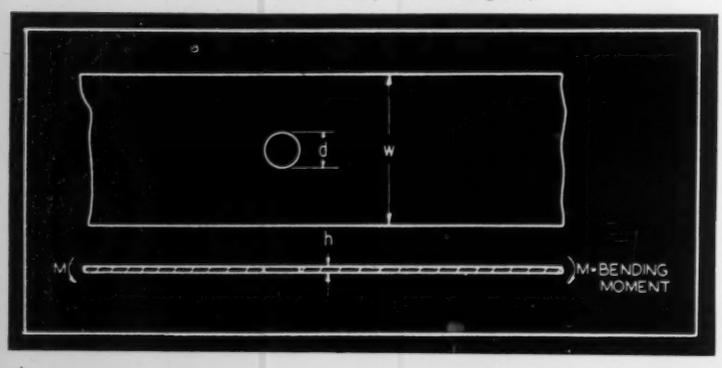


Fig. 2—Theoretical stress concentration factors for strips with holes in bending. Lower curve may also be used for semicircular notches in side of spring

Fig. 3—Flat spring with hole relatively large in diameter compared to thickness. In this case lower stress concentration factors may be expected. For small ratio d/w and d/h, factor is 3 compared to a factor of 1.85 for small d/w and large d/h



STRESS concentration effects due to holes, notches, sharp bends, sudden changes in section or clamped edges are vital factors affecting the useful life of flat or leaf springs under frequently repeated loadings. Endurance diagrams for spring materials showing the reduction in fatigue strength due to surface effects are discussed in this article, while curves are given for evaluating stress concentration factors in typical cases.

In the preceding articles (MACHINE DESIGN, January and February, 1940) methods for calculating nominal stresses[1] and deflections in typical flat and leaf spring applications were treated. The effect of these nominal stresses, however, in many cases is augmented by *stress concentration*. If the spring is under a purely static loading or if the loads are repeated relatively few times, such stress concentration effects may usually be neglected in practical design for spring materials of good quality. However, where fatigue or repeated loading occurs, careful consideration should be given this problem by the designer, since otherwise cracks may start at localized points of stress concentration and precipitate complete failure of the spring.

Fatique Factor Approaches Theoretical Value

To take stress concentration into account it is necessary to know the range of nominal stress to which the spring is subjected[2]. The stress is then divided into a mean stress S_o and a variable stress S_v. If S_{max} and S_{min} are the maximum and minimum nominal stresses, then $S_o = \frac{1}{2}(S_{max} + S_{min})$ and $S_v = \frac{1}{2}(S_{max} - S_{min})$. All evidence available from fatigue tests indicates that the mean or static stress S_o may be calculated by neglecting stress concentration while the variable stress S_v should be multiplied by a factor to take into account the reduction in endurance limit due to stress concentration. In general this factor (often called a fatigue strength reduction factor K_f) will be somewhat lower than the theoretical stress concentration

1. Nominal stresses are stresses figured in the usual way by dividing the bending moment by the section modulus of the minimum or net section.
2. See author's article in MACHINE DESIGN, January, 1938 for a more complete discussion.

nd Notches Affect

By A. M. Wahl
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factor K_t = peak stress divided by nominal stress, as determined from photoelastic tests, strain measurements, or mathematical analysis. The difference between K_t and K_f depends on the size of part and kind of material. However for fine-grained, high-strength materials and particularly alloy steels as used in springs there is a tendency for the actual fatigue factors K_f to approach the theoretical factors K_t even for relatively small test specimens[3]. For this reason, in the absence of actual test data, the K_t values given here will usually yield results on the safe side and hence may be used as a basis for design.

Effect of Holes on Stress Concentration

Frequently it is desirable or necessary to provide a hole in a flat spring for holding the spring in place or for manufacturing reasons. A common example is the semielliptic automobile leaf spring which is usually provided with a hole in the center to hold the leaves together.

For flat springs having holes small in diameter relative to the spring thickness, as shown in *Fig.* 1, (this may occur in large and heavy plate springs) it appears reasonable to use as a basis the results of photoelastic tests on tension bars with holes[4]. The upper curve of *Fig.* 2 shows values of theoretical stress concentration factor K_t determined photoelastically as a function of ratio d/w between hole diameter and plate width. Thus where this ratio is small the factor K_t approaches three, a well known result for a plate in tension. However, for very small holes it is possible that the actual fatigue strength reduction factor K_f will be considerably less than three since here the "size effect" may be quite pronounced.

On the other hand, for thin springs (for example those made of clock spring material) where the hole diameter d is large compared to the strip thickness h as shown in *Fig.* 3, both tests and theory indicate

3. This is discussed in an article by R. E. Peterson and the writer, *Journal of Applied Mechanics*, March, 1936.
4. See *Transactions*, A.S.M.E., August, 1934, p. 617, and *Mechanical Engineering*, August, 1936, p. 485, for a description of such tests, together with theoretical stress concentration factors.

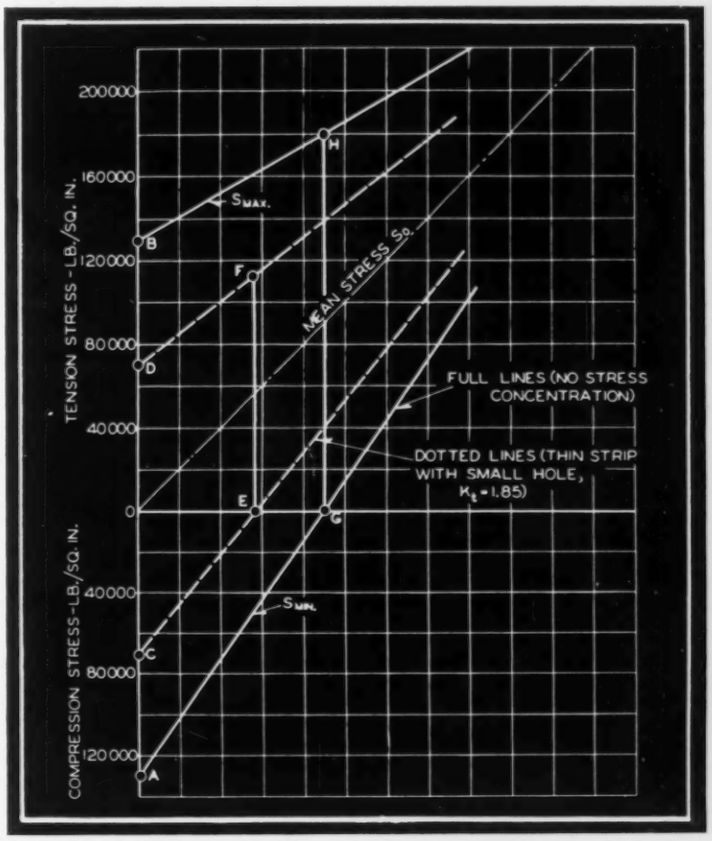
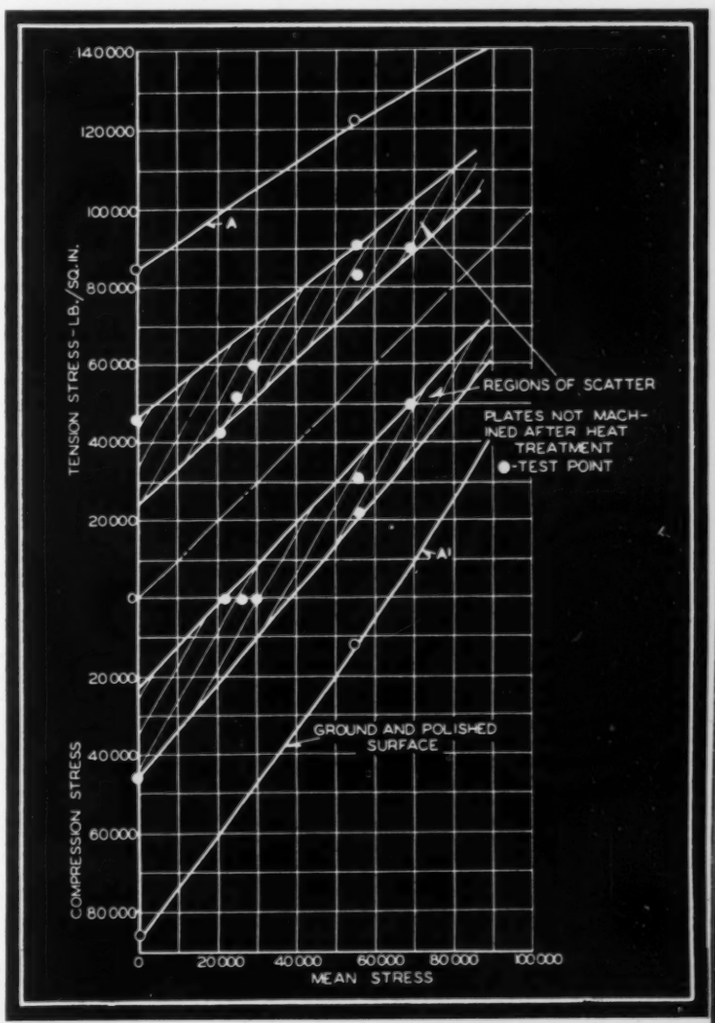


Fig. 4—Endurance curves for thin high grade spring steel strip. Thickness .006 inch, surface ground and polished

Fig. 5—Typical endurance curves on leaf spring material



considerably lower values of K_t will exist than is the case where the d/h is small. A mathematical analysis by Goodier[5] shows that for a small hole in a wide strip under pure bending in one direction where d/h is large this factor $K_t = 1.85$, which is considerably smaller than the value of 3 found for a thicker plate where d/h is small. Since, when the hole diameter approaches the strip width a factor of 1 may be expected, the probable shape of this curve is that shown dotted in *Fig.* 2 for large d/h.

Variations Due to Size Effect

The application of these stress concentration factors is illustrated by the curve of *Fig.* 4 which shows an estimated endurance diagram for a very high quality spring steel strip in a ground and polished condition, thickness .006 inch. The endurance limit of this material was found by test carried out by T. F. Hengstenberg of the Westinghouse Research Laboratories to be $\pm$ 130,000 pounds per square inch in reversed bending while the ultimate strength was 275,000 pounds per square inch. It may be expected that the material when subject to a stress range between S_{min} and S_{max} will have a characteristic approximately as shown by the full lines. Thus the stress range for complete reversal is between points A and B or between + 130,000 and — 130,000 pounds per square inch. For a range from 0 to maximum the limiting points are G and H from 0 to 180,000 pounds per square inch.

Now if a small hole is put into the strip, assuming that d/w is small and d/h large, *Fig.* 3, the factor $K_t = 1.85$. Since this material will probably be fairly sensitive to stress concentration, it may not be so far off to assume that the fatigue strength reduction factor K_f is approximately equal to this value. On this basis a strip with a hole would show a diagram as indicated by the dotted lines of *Fig.* 4, the points C and D representing nominal stresses of $\pm$ 130,000/1.85 = $\pm$ 70,000 pounds per square inch. The ordinates between the mean stress line S_0 and either the upper or lower full line are also divided by 1.85. Thus a zero to maximum stress range, for the strip with the hole is represented by the line EF or 0 to 112,000 pounds per square inch. In this case therefore the strength for this type of stress application has been reduced by the presence of the hole from 180,000 to 112,000 pounds per square inch or by a factor of 180,000/112,000 = 1.6. This is considerably less than the fatigue strength reduction factor assumed for completely reversed stress which was 1.85. The difference is a consequence of the assumption that stress concentration effects may be neglected as far as the static component of the applied stress is concerned.

It should be noted that actual tests would probably show a somewhat higher endurance limit for the strip with a hole than the figures determined in this way due to "size effect" for such a thin material; in any case, however, the method of calculation should be on the safe side for design.

The curve of *Fig.* 4 represents the values to be expected for an exceptionally high grade material in a thin size (.006 inch thick) and with the surface in a very good condition, i.e. ground and polished. For the thicker sections, such as are used in leaf and plate springs, with the surface in the condition left by roll-

5. *Philosophical Magazine,* Vol. 22, 1936, p. 69. This work has also been checked experimentally by C. Dumont using strain measurements on a large aluminum plate. See N.A.C.A. Tech. Note No. 740.

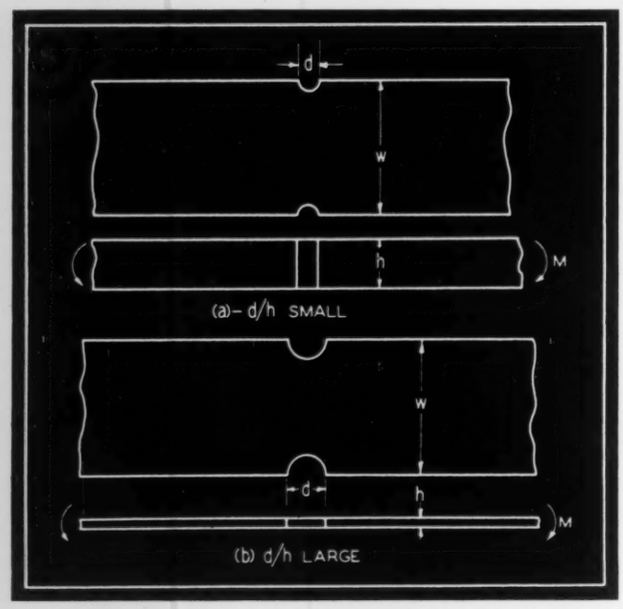


Fig. 6—Notched strips in bending. For (a) use curve of Fig. 7 and for (b) use lower curve of Fig. 2

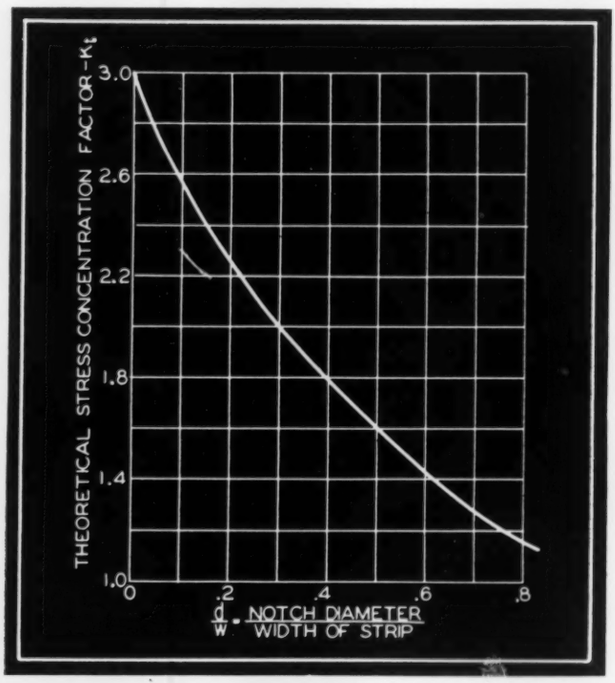


Fig. 7—Theoretical stress concentration factors for semicircular notches in thick strips, d h being small

ing and not ground after heat treatment, on the basis of available test data very much lower values of endurance limit may be expected than those shown in *Fig.* 4. The results of endurance tests on typical steels as used in leaf springs are indicated in *Fig.* 5. The upper and lower curves A and A' represent the results of tests on a typical steel as used in leaf springs with surfaces ground to remove the decarburized layer left by heat treatment. The points in the shaded area represent test results reported by Hankins[6], Batson and Bradley[7], and Houdremont and Bennek[8], on springs with the surface untouched after heat treatment. It may be expected that for actual leaf springs the results of endurance tests will fall somewhere within the shaded area shown; in any case a lowering of the endurance range to from one-quarter to one-half that found for machined or ground specimens is to be expected as a consequence of the decarburized layer left by heat treatment. However, for high quality materials and carefully controlled heat treatments it is possible that improved results may be obtained over the values indicated in *Fig.* 5.

Effect of Notches and Clamps

It should be noted that if stress concentration effects (holes, notches, etc.) are present the values of limiting stress range as shown in *Fig.* 5 are reduced to still lower values.

The stress concentration effect of semicircular notches in flat springs may be estimated as follows. If the plate is relatively thick so that the ratio d/h between notch diameter and plate thickness is small as indicated in *Fig.* 6*a*, it appears reasonable to apply the results of photoelastic tests on notched bars in tension[9]. In *Fig.* 7, the values of theoretical stress concentration factor K_t as found in this way is plotted as a function of the ratio d/w between notch diameter and plate width.

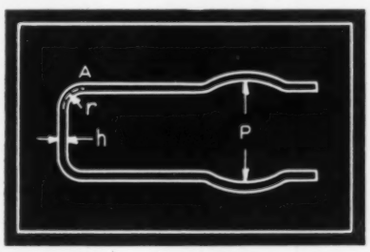


Fig. 8—Spring clip showing stress concentration effect due to sharp curvature of bend at A

For semicircular notches in *thin* strip materials as shown in *Fig.* 6*b* where the ratio d/h is large, it is reasonable to expect that the factor K_t would be practically the same as that for a strip with a hole of the same diameter d and the same width w. It is therefore suggested that the lower curve of *Fig.* 2 may also be used as an approximation for this case. The dotted curve of *Fig.* 4 may therefore represent the endurance diagram for the case of a wide strip with semicircular notches under bending (where d/h is large, d/w small).

In forming flat springs sharp bends are frequently used. An example of this is the bend at A in the spring clip shown in *Fig.* 8. Because of their sharp curvature, these bends introduce a further stress concentration effect which may be taken into account for repeated loading by using a stress concentration factor K_t derived from curved bar theory[10]. Values of K_t for various values of the ratio r/h between mean radius of bend and thickness of material are given in *Fig.* 9. It may be seen that this factor K_t increases rapidly as

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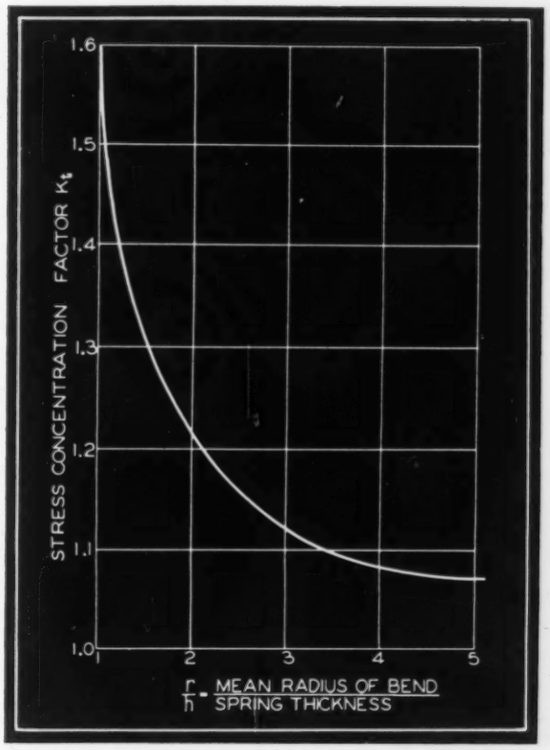
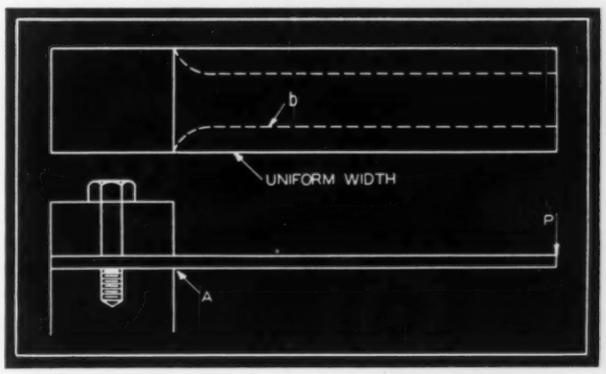


Fig. 9—Stress concentration factors for sharp bends

Fig. 10—Flat spring with clamped end. Stress concentration occurs at A due to clamping pressure



6. Dept. of Science and Industrial Research, Spec. Report No. 5.
7. *Journal Institution of Mechanical Engineers*, 1931, p. 301.
8. *Stahl und Eisen*, July 7, 1932.
9. See references given in footnote 4 for results of such photoelastic tests.
10. Timoshenko: *Strength of Materials*, Part II, p. 423, Van Nostrand, 1930.

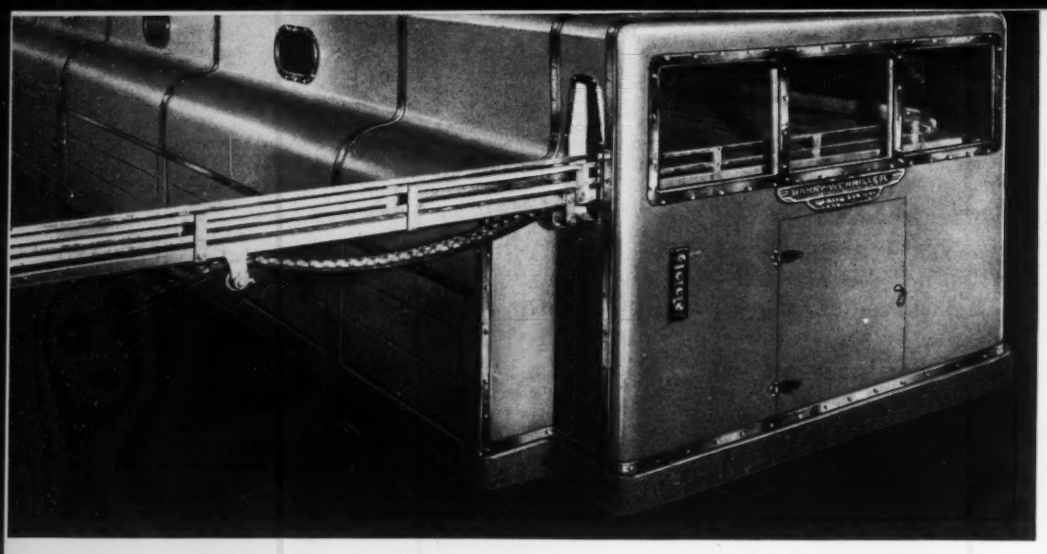


Fig. 1—Pasteurizer from infeed end. Three-section, sheet steel rolling doors may be seen in lower portion of side. Quick-opening glass windows permit observation of operations within

Pasteurizer Features Walking Bea

IN COMMON with other machinery used in food processing, the Vortex pasteurizer in *Fig.* 1, made by Barry-Wehmiller Machinery Co., St. Louis, involved design problems such as power transmission consistent with the slow motion of the machine; maximum dependability, to prevent spoilage; insurance against corrosion; cleanliness and good appearance; and anticipation of an extreme amount of variation in sizes of individual machines with the same operating principles. Basically, the machine is an enclosed conveyor through which pass bottled or canned foods subjected to a series of water sprays of varying temperature.

Most daring individual feature of the machine is a new version of the familiar walking beam applied to the conveyor. It was developed with special attention to the peculiar requirements of such a mechanism for conveying large numbers of bottles as small as two inches in diameter. An average sized pasteurizer will contain between 9000 and 10,000 filled bottles at one time, while a figure of 20,000 is not uncommon.

Utilize Two Movable Grates

The usual walking beam conveyor consists of one stationary grate together with an interlocking movable grate. The movable grate lifts the load from the stationary grate, advances the load for a predetermined distance, and deposits it on the stationary grate while the movable grate returns to its position to repeat the cycle. Power requirement for such a type of walking beam in the pasteurizer would have been prohibitive inasmuch as it would have included the repeated lifting of the weight of such quantities of bottles as mentioned above. It was determined, therefore, to have the walking beam conveyor consist of two movable grates, with the mode of operation as follows.

Reciprocating Motion Required

Grate A, carrying the load, moves forward a predetermined distance while grate B moves in the opposite direction at a lower level. At the end of the forward movement of grate A, grate B is raised flush with grate A. The latter then drops to the level previously occupied by grate B, and grate B, now carrying the load, moves forward the predetermined distance. In this way the load on the conveyor is never lifted and the power required is only the tractive power needed to draw the loaded conveyor on tapered roller bearings, as the grates themselves are counterbalanced and thus require no considerable amount of power for their up and down motion.

It is obvious from the above description that the only type of motion required to drive the pasteurizer is reciprocating motion. The working surface of the conveyor is composed of a series of ⅛-inch by 1-inch brass strips running longitudinally on edge through the pasteurizer. Strips are placed closely enough together to provide a steady support for the containers and yet far enough apart to allow space for the strips of the interlocking grate plus sufficient clearances for particles of broken glass to fall into the reservoir.

By William Nekola
Barry-Wehmiller Machinery Co.

a New Version

At suitable intervals the strips are fastened to crosswise supports which extend to the outside of the machine through apertures in the sidewalls of the tank. These cross members are secured to longitudinal channel irons which run practically the full length of the machine. Each cross support on each grate is fastened to a channel on each side of the machine. Thus, in the channel irons is available a means of support and a source of anchorage for the tractive power necessary to operate the grates.

To provide the up and down motion for transferring the load from one grate to the other, a supporting casting anchored to the floor carries a rocker arm which supports the longitudinal channels on a large diameter roller provided with tapered roller bearings. These supports are in series, in accordance with the length of the machine, and the motion of the rockers is articulated by means of connecting links, as *Fig.* 2 shows.

At the left of the machine, in place of the articulating linkage, is an hydraulic cylinder which with its reciprocating motion causes the rockers to move through an arc sufficient to raise and lower the grates. Toward the extreme right end of the long grate supporting channels an hydraulic cylinder anchored to the floor on each side of the machine imparts, through a gear segment and linkage mechanism, the necessary forward and reverse movement to the grates.

Pilot Valve Controls Sequence

The sequence of all these motions is controlled by a pilot valve tripped by the forward and reverse mechanism at the end of each stroke through a series of four-way and sequence valves in the hydraulic system at extreme right of *Fig.* 2. The grate operation is thereby carried on as described above. Variable speed control is achieved by means of an oil volume control valve at upper right with a calibrated dial which can easily be set by the operator of the machine.

This type of drive is particularly suited to the pasteurizer because it dispenses with the necessity for any reduction gears or cam movements. The entire drive is self-contained within the enclosure of the machine. Motor and pumps are mounted above the oil reservoir tank, and easy access to it and to the valve assembly is provided through doors in the outer casing of the pasteurizer.

Several different aspects of the corrosion problem

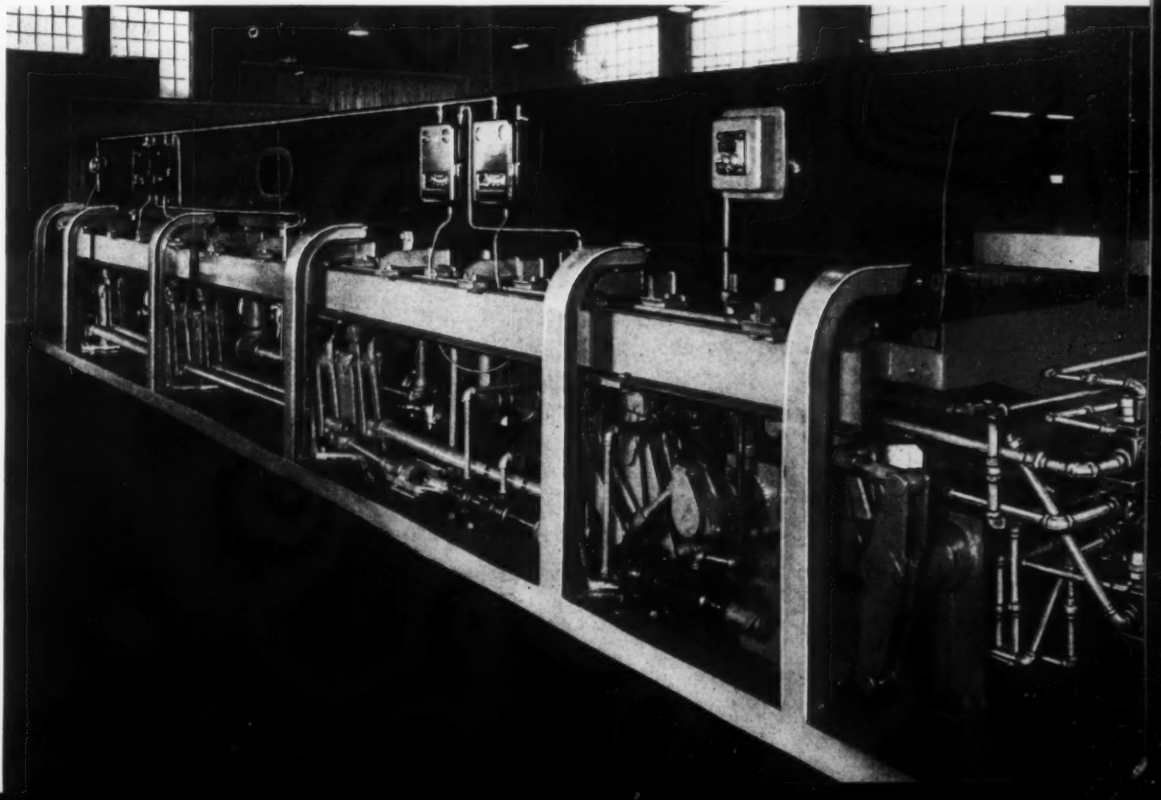


Fig. 2—Jacket has been removed from pasteurizer. Curved supports for upper sidewall incorporate tracks for rolling doors. Hydraulic cylinder to left operates articulating linkage for lifting and lowering conveyor grates; cylinder to right accomplishes back and forth movement of both of the grates

presented themselves, all arising of course from the spraying action on bottles and cans. The simple expedient of using rustproof materials throughout was not feasible because some of the larger pasteurizers weigh 40 tons or more. Such masses of expensive metals would make the cost of the equipment prohibitive, and it was therefore mandatory that a great proportion of the machine be made of steel or iron.

For relatively small parts subjected to direct action of the water heavy galvanizing is satisfactory. But large exterior surfaces of the machine together with castings and other mechanical parts presented a problem in resistance to hot water vapor and condensate. After many tests a zinc chromate primer was adopted and for final finish of the outside of the machine where sanitary appearance was of great importance a white synthetic enamel proved durable.

The interior surface of the reservoir tank, the upper sidewalls above the conveyor, and the inside of the

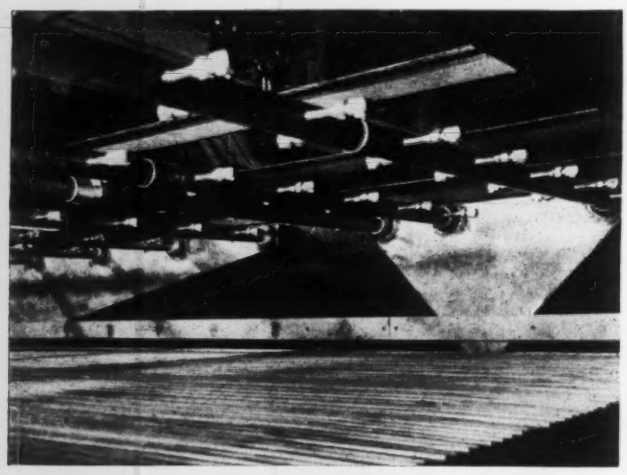


Fig. 3—Interior view, showing copper manifold pipes and bronze nozzles, with walking beam grates below. Pebbly surface on sidewall and upper cross angles is a special rubber protective coating. Note welded Muntz metal water ducts designed to minimize water friction

top covers also had to be protected, but all of these parts are sheet steel fabricated by welding, which made any precoating of them out of the question. Moreover, they are directly subject to the most severe action of the hot water, and the sloughing off of rust particles would contaminate the recirculated water and present a menace to the operation of pumps and nozzles.

No paint of any kind was found to be satisfactory for this portion of the machine and the sizes of these parts were much too great for handling in galvanizing or any similar process. Finally a reclaimed rubber compound was found, capable of application with special spray gun equipment and forming a coating from 1/16-inch to ⅛-inch thick. Its characteristics actually improve under use and it has the added advantage that when alterations or field welds have to be made the coating can easily be repaired by troweling the compound. The pebbly surface on the sidewall and upper cross angles in *Fig.* 3 is this rubber protective coating.

Because it was desirable to minimize wastage of process heat, extensive experiments were made on the heat transference properties of water with careful attention to the effect of different volumes of water. Finally a volume of water was determined which, properly distributed over the containers, provides a maximum efficiency of heat transfer. An increase over this volume resulted in no perceptible increase in heat transfer.

Since spray nozzles were indicated for distributing a given volume of water over a given area, clog-proof nozzles had to be found which covered the area assigned with a solid cone spray at low pressure. Very little horsepower is required to operate the pumps for recirculating this water. To insure that nozzles do not clog and spoil products through improper spraying, screens were added in front of the pump suction to prevent debris from fouling either the manifolds or the nozzles. These screens are flexible belts made of woven bronze wire and extend out of the reservoir above the water line on a drum pulley mechanism enabling them to be cleaned as operating conditions require.

Operator Convenience Sought

Every possible provision has been made in the machine for operator convenience. On each machine is a minimum of five electric motors including the hydraulic drive. A switch box assembly was developed containing within a single case, mounted at any convenient location, all the necessary overload relays and magnetic switches. A pilot-lighted pushbutton station at each end of the machine provides for operator control and the relay system is so designed that overload on any one motor shuts down the entire machine. It is possible, however, to run any motor individually by altering the setting of the individual magnetic switches within the switch box.

A highly important consideration in the design, which remain essentially the same, was the great number of required sizes for individual machines, since there is no such thing as a stock size for an in-bottle pasteurizer. Greatest size variation is in length, because there are fewer restrictions than in width, the building bays where the machines are installed being customarily no wider than 20 feet. Lengths increase in 6-foot 6-inch steps to 68 feet 6 inches or more. To hold special work to a minimum, all detail design possible was keyed into the 6-foot 6-inch units. Conveyor grate bars are obtainable in 13-foot lengths while cross-wire supports are spaced every 2 feet 2 inches.

The sheet steel exterior jacket of the machine has at least one novel feature in its provision for access

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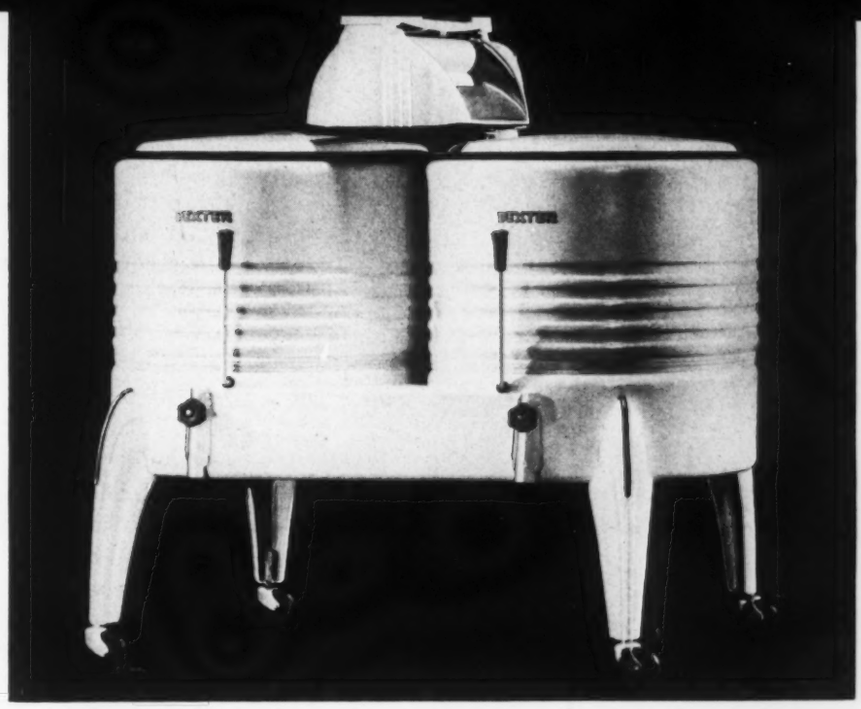
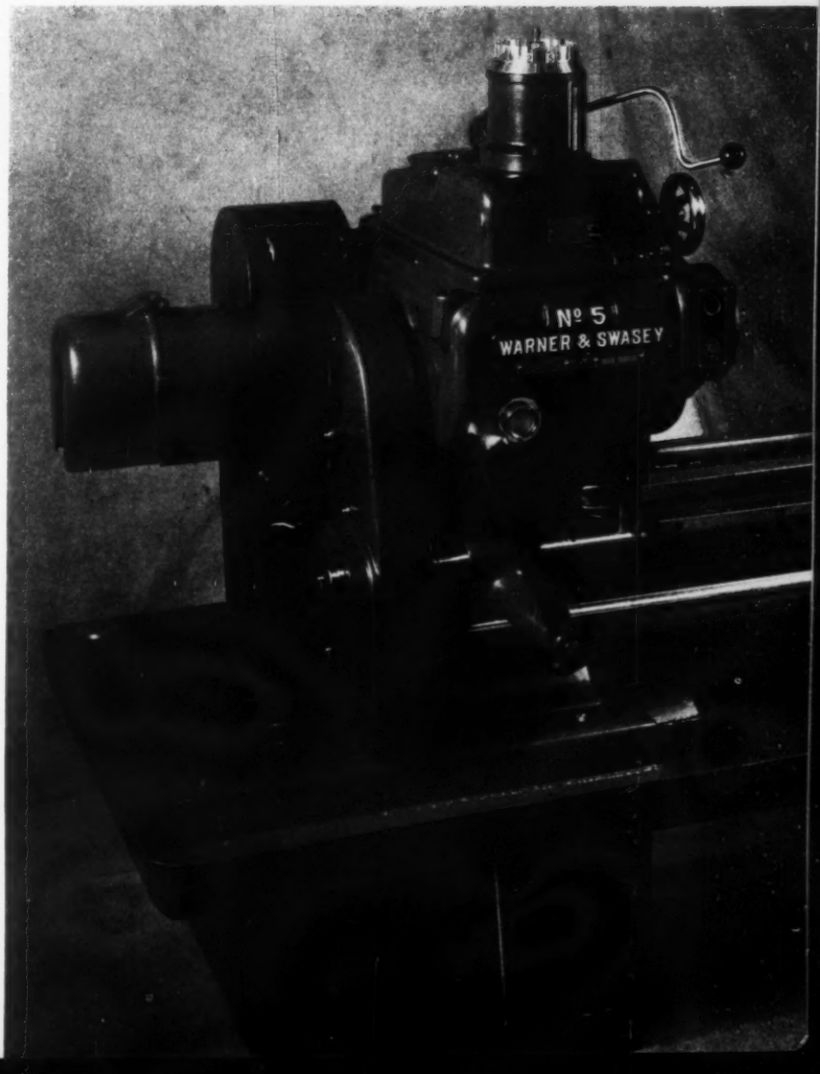


Fig. 1—Right—In a washing machine, resistance to alkalies is particularly important in a finish. White baked enamel is a smooth, glossy exterior

Fig. 2—Below—Finishes on a lathe are subject to severe punishment and withstand action of lubricants, coolants

Designers' Problems Made Easier by Newer Finishes

By George Z. Griswold



STRONG trends in the last decade toward recognition of the sales value of attractive finishes, spread of "cleanlined" contours for machines, and the realization that properly chosen and applied finishes can serve many utilitarian purposes, have served to focus increased attention on the finishing problem. But until comparatively recently, application of external finishes was looked upon as a necessary evil, a routine procedure to satisfy whims of customers, one to be accomplished as quickly as possible.

One peculiar hold-over from the former indifferent attitude on finishes may be cited. In certain specific cases the cost of the actual lacquer finish needed for covering a machine costing around $5000 has been approximately $10, exclusive of labor and preparations. Manufacturers have been known to specify an inferior finish costing a few cents less per gallon than a vastly superior one. Perhaps the aggregate sum of money involved in a year's production is sizable, but surely the freedom from subsequent complaints would be worth the small additional unit expenditure for a finish suited to the application in question.

It is pertinent, therefore, to discuss latest de-

velopments in finishing with respect to their effects on design, and to show some typical examples of finished machines. Because the subject of metallic finishes—stainless steel, cadmium, chromium, aluminum, etc.—would unduly expand the scope of this article, mention will be made only of organic coatings such as paints, enamels, lacquers and the like. Plastics will be treated only insofar as plastic materials are used as bases.

Present trends in finishes naturally are greatly influenced by the demands made by designers on organic coatings applied to machines. As their primary purposes, finishes afford protection of the metal beneath from rust, chemicals, or other corrosion; provide decoration, resulting in increased attractiveness and sales; aid cleanliness, particularly in industries such as baking and dairy products; and increase effectiveness of workers, as when different colors indicate a given sequence of operations to a worker.

Refinements of these purposes are being found, however, and include increased durability, resistance to heat, and reduced finishing time, through as rapid drying and hardening as possible. Probably as a result of the intensive research being done on plastics, most of the advances in finishes have come recently in the field of synthetics.

Washer Epitomizes Trends

Many of the latest trends are epitomized by the white baking enamel on the washing machine in *Fig.* 1. In addition to having greatly increased durability and resistance to moisture and alkalies, this finish was required to possess excellent flow qualities during application so that a smooth and glossy finish would result. In general, of course, a finish with a high percentage by volume of a nonvolatile oil in comparison with the pigment will tend to be glossy, since during drying the oil floods the pigment and causes it to recede from the surface. And in a washing machine alkali resistance is perhaps disproportionately important, particularly if the water evaporates from the soap and leaves a strong alkali solution.

Reduced finishing time is a strong trend. Older baking enamels, for instance, required from several hours to a day or more from application until becoming hard enough to handle and wrap. This time has been progressively reduced, and now finishes are available that air dry in a few minutes, bake in 10 or 15 minutes and are ready to handle in less than an hour. Quality of the finish tended to deteriorate somewhat when first experiments were conducted along the lines of decreased baking periods at higher temperatures, but this difficulty has been overcome.

It is important to realize that the rapidity of baking depends largely on the mass within an oven. In the case of the washing machine in *Fig.* 1, cast parts and sheet metal had to be finished and baked simultaneously after assembly. But because of the thinness of sheet metal, the enamel on it baked much faster than that on more bulky castings. Hence a finish had to be developed which would permit heating the metal to the point where the enamel on the castings would bake, but at the same time the finish on the sheet metal could not be permitted to deteriorate or discolor.

Two new types of lacquers, or finishes containing nitrocellulose as a nonvolatile element, are illustrated on the machines in *Figs.* 2 and 3. Finishes on a lathe of course are subject to severe punishment and must withstand chemical action of lubricants and coolant solutions. The lacquer shown in the unretouched photograph has a hard gloss in the standard machine tool gray. It must be able to resist blows from tools laid

Fig. 4—A heat-reactive phenolic type resin is used on this rayon spinning bucket and is unaffected by the highly acid spin-bath

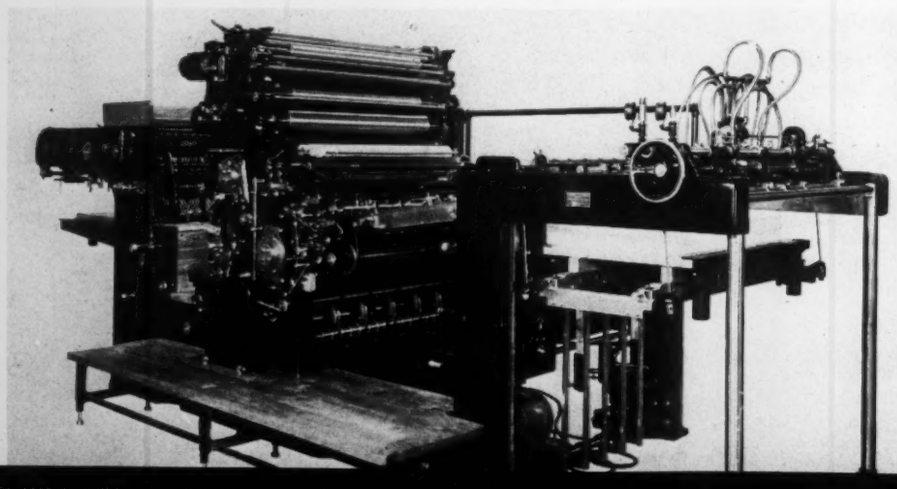


Fig. 3—Offset lithographing machine has a hard lacquer finish, resistant to ink and various lubricants

down hurriedly by operators. Ink and lubricants must be resisted by lacquer on the lithographing machine.

Although many finishes have layers of primers and fillers beneath them, it is often desirable to rustproof the metal, except in the case of nonferrous metals or stainless steel. Methods like bonderizing and parkerizing are efficient preventatives of rust in case the exterior should be broken. Parkerizing is a typical method, consisting of immersing metal in a nearly boiling chemical solution which changes the surface to an insoluble phosphate impervious to rust under ordinary conditions. The process requires considerable time, however, and hence may be expensive.

Some of the progress leading to faster baking schedules is also attributable to new methods of applying

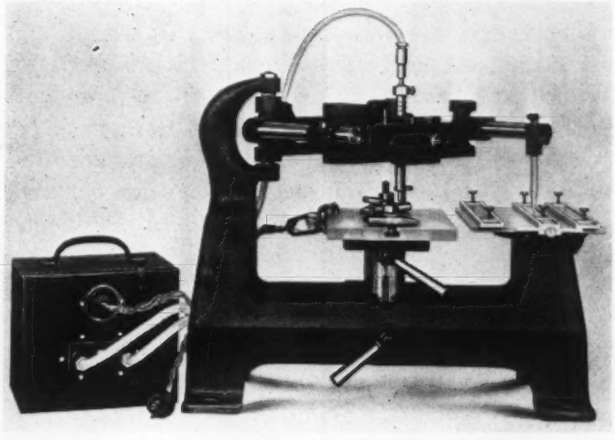


Fig. 5—Panto engraver has a gray wrinkle finish applied in one baked coat. Former limitations of wrinkle have been greatly reduced, enlarging its scope

heat. A process introduced last year, in which heat is supplied by "near infra-red" electric lamps or radiant-heat ovens, bakes the finish from the inside out, instead of vice-versa as formerly. This method is discussed on page 38 of this issue. Very recently, finishes were developed to take full advantage of the special features of this process, baking in 20 minutes.

Heat-reactive coatings—i.e., finishes that must be hardened or polymerized by heat before becoming permanently infusible and insoluble—offer special advantages such as resistance to melting at any temperature and to charring up to 300 degrees Fahr. or even higher. Even at elevated temperature they are unaffected by common solvents and many acids. An example to such a finish is that on the rayon spinning bucket in *Fig.* 4. As filaments of rayon are gathered into a bundle in the bucket they carry considerable spin-bath solution, a highly acid medium. Aluminum alloys are used for the part because of their high strength-weight ratio, but they would be impractical except for a protective coating. After a preliminary chemical treatment to promote a good bond between the coating and the aluminum, a heat-reactive phenolic type resin is applied by spraying. Because the bucket

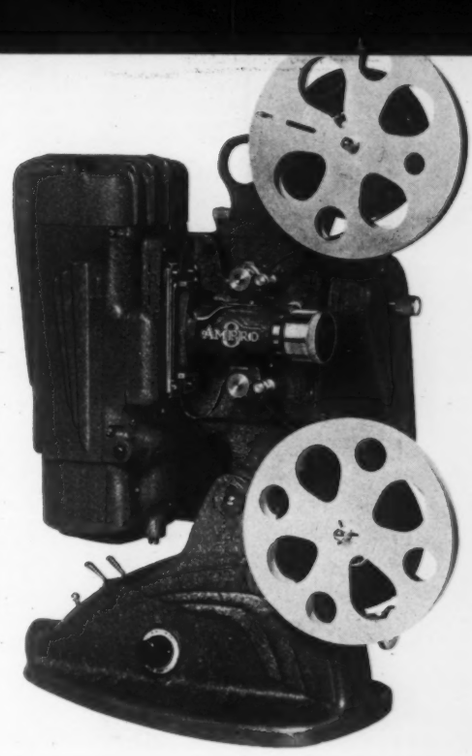


Fig. 6—Wrinkle offers an attractive, unusual finish for many consumer machines, as on this movie projector. Light colored wrinkles are now available

must be delicately balanced it is rotated in a fixture during spraying, to promote uniformity in coating. Three coats of a pigmented primer are followed with three coats of the resin solution, each coat being followed with a baking operation. After the final coat a longer and higher temperature bake is used to give a smooth impervious finish.

Wrinkle finishes have been popular for some time, particularly when the metal beneath is rough and it is desired to apply only one finish. Under those conditions wrinkle finishes in a variety of colors may be used to give a durable and attractive exterior, the wrinkles actually blending with the roughness of the metal. *Figs.* 5 and 6 are two excellent examples of machines with wrinkle. Limitations such as the fact the base material darkened when baked, formerly restricted wrinkle finishes to dark colors. Hardening times were comparatively long and wrinkle patterns were large. With the removal of these limitations, the field of application of wrinkle has been extended greatly. White and light colored wrinkles have been added.

In addition to cases calling for comparatively standardized finishes, many special situations arise which necessitate considerable extra work to arrive at a finish with the desired quality and properties that can be applied for the lowest unit cost. The great strides being made in finishes in general should permit the designer to find a finish which meets his specifications.

Acknowledgement is given the following companies for their co-operation in the preparation of material for this article: Aluminum Co. of America (*Fig.* 4); Bakelite Corp.; Dexter Co. (*Fig.* 1); Durez Chemicals & Plastics Inc.; General Electric Co.; Glidden Co.; Harris-Seybold-Potter Co. (*Fig.* 3); Hilo Varnish Corp.; Maas & Waldstein Co.; New Wrinkle Inc. (*Figs.* 5 and 6); Roxalin Flexible Lacquer Co.; Sherwin-Williams Co. (*Fig.* 1); Warner & Swasey Co. (*Fig.* 2).

Photoelastic Analysis in Commercial Practice

By R. E. Orton
Acme Steel Company

Part III

IN PHOTOELASTIC analysis the care with which the models for observation are made and the accuracy with which the polariscope is calibrated are determining factors in the successful studies of stress values. This article, Part III of a series, discusses concisely annealing, polishing and shaping of models as well as the technique of using and adjusting the instrument. Also, the construction of a practical annealing oven is covered.

Owing to the wide variations in properties between different model materials it is advisable to use but one until its properties are fully known. The writer has found Bakelite, type "BT-61-893 Water White," to be a good general purpose material. It is easy to work, of a good sensitivity, fairly uniform in quality and easy to obtain. One-quarter-inch thickness is recommended unless the other lateral dimensions are great enough to make buckling a problem. Too thick a material accentuates some of the problems and is to be avoided. Theoretically also, the thicker the material the greater the departure from plane stress.

For model making a combination jig saw and filer is required. There are several low priced machines available that are satisfactory for this work. Jig saw blades, .11 inch by .02 inch with 20 teeth to the inch, are satisfactory for rough sawing; fret saw blades, .045 inch by .01 inch with 18 teeth, may be used for the final sawing. One crochet file is useful for general utility and special shapes as required by the model. A speed of 800 revolutions per minute is recommended for both sawing and filing. The machine shop sensitive drill press may be used for drilling if care is observed to avoid scratches, etc. For polishing, a metallographic lap equipped with three 6 inch wheels and adjusted to about 800 revolutions per minute is useful.

Bakelite as received is rough sawed across its face similarly to a disk cut from a log. The first step is to cut out a rectangular block with the jig saw. Edge of block should lie ⅜ inch to ½ inch outside of the finished outline because of the drop off in thickness in the polishing.

Preliminary polishing is with waterproof sandpaper, 180 grit, used dry with a moderately light pressure until all traces of the original saw marks have been removed. Position of the block should be

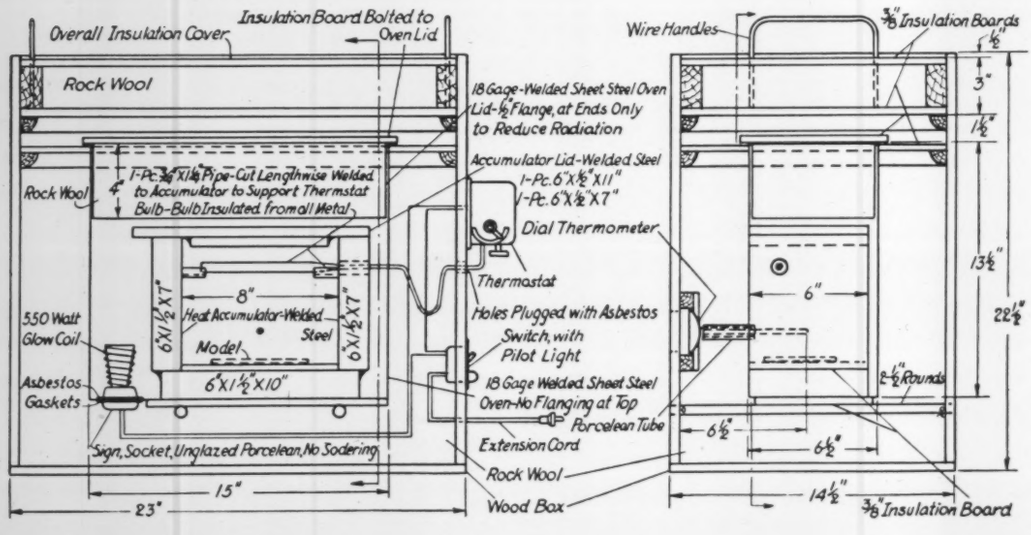


Fig. 13—Construction of annealing oven suitable for treating models for photoelastic analysis

altered frequently to avoid sanding more at one edge than the other, tapering the thickness. Then the model is dry polished with the same type paper, 400 grit, until the first sanding marks have disappeared. After this and all succeeding polishing, model should be flushed thoroughly in clean water at a temperature close to that of the model. Next, the 400 grit paper is wetted down thoroughly for polishing until smooth and semitransparent.

Change is then made to a polishing wheel covered with metallographic polishing broadcloth, thoroughly wetted with water. Polishing is continued with 400 grit alundum applied with a 250 cubic centimeter

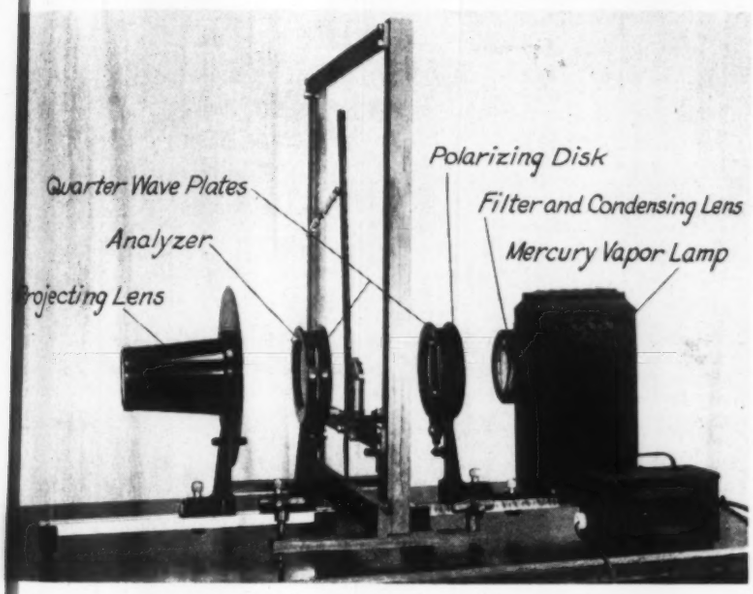


Fig. 14—Polariscope with component parts indicated. Straining frame with model is in position

Erlenmeyer flask, filled about ¼ inch with the powder and half filled with clean, preferably distilled, water. Top is closed with one hole rubber stopper with a short glass tube inserted. Frequent shaking is required to maintain suspension. With a few small drops upon the disk, polishing is done with a light pressure, changing position frequently and oscillating model slightly. After 15 or 20 seconds of polishing a few more drops of the polishing mixture should be added. Wheel should be flushed free of powder frequently. A few minutes polishing will bring the model to a good texture and almost perfectly transparent.

Final polishing is as above, using a fresh wheel and cloth and a suspension of levigated alumina, in another Erlenmeyer flask. Great care should be taken to clean off the former polishing particles. A very light pressure should be used and position changed continually to avoid scratches. Model should be flushed off frequently in water. When the polishing is completed the block will be as clear as window glass. Examination with a strong magnifying glass should show very few scratches. An occasional large scratch will not matter, but a multitude of very fine scratches will prove ruinous. Polishing wheel may be cleaned by holding a small scrub brush against the revolving wheel, flushing copiously with water. After polishing, block is ready to be annealed.

Annealing oven construction is shown in *Fig.* 13. The large mass of steel is to insure uniformity of temperature and a slow cooling when the heat is turned off. It also shelters the model from the direct heat of the glow coil.

Annealing temperatures between 300 degrees and 320 degrees Fahr. have been found to be best, considering the time available for commercial work. Model temperature should not rise above about 350 degrees, although there seems to be no harm in heating as rapidly as possible. About three hours is required to bring the oven to a stabilized temperature. Two hours soaking is recommended after this point is reached. Then heat may be cut off. If oven has been properly made and insulated the cooling rate will not exceed 20 degrees per hour at the start, and will drop considerably below this as the temperature falls. At the end of about fifteen hours the temperature will be down to 150 degrees, at which point it will probably be necessary to remove the overall insulating cover to increase the rate of cooling. By the following morning the oven lid may be removed. It is best to leave oven open for an hour before removing heat accumulator lid, to insure model not being too far from room temperature.

It is suggested that a trial run be made first to acquaint oneself with the cooling characteristics of the particular oven. Model should be fully supported along its face on a piece of Transite or other suitable insulating board, to prevent warpage. The annealed blank need not be used at once but may be

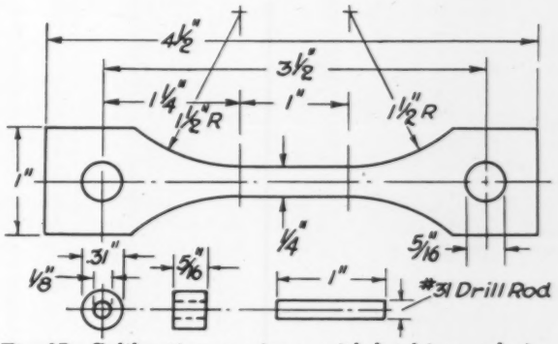


Fig. 15—Calibration specimen with bushing and pin

stored provided it is protected against sudden changes in temperature and excessive drying or humidity. Annealed block should not show a pattern of more than one-fourth of an order, and if properly done will generally show less than that. Bakelite will usually shrink 2 to 3 per cent in annealing.

It is advisable to do the drilling now, as this

operation offers the greatest risk of breakage. Slow spindle speed (about 400 revolutions per minute on 5/16 inches diameter) and a light pressure are necessary. Model should be backed with a clean smooth piece of hardwood. Great care must be observed at the "break through" to avoid chipping of the lower face. Drills should have very little lip clearance, using no lubricant. Reaming is best done by hand to avoid risk of seizure. Drilling may produce an appreciable fringe pattern, most of which will disappear in a short period.

Making of the model blank is the next step. A

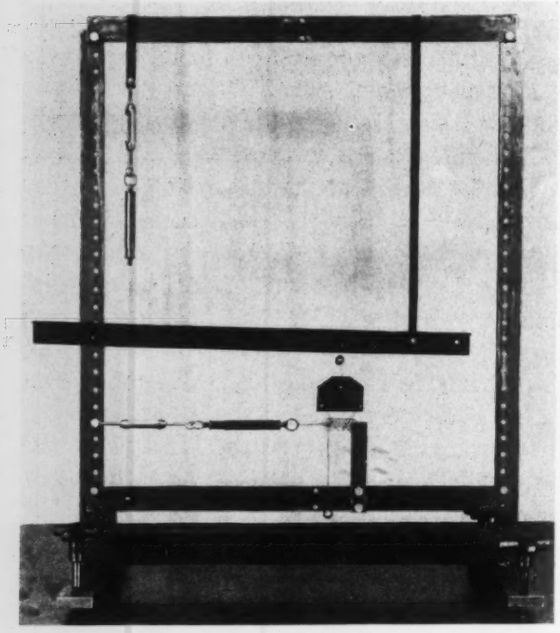


Fig. 16—Straining frame with model in place with turnbuckles and spring balances for applying loads

tracing paper template 1/16 inch outside the finished model outline, fastened to the block with rubber cement, aids in sawing to outline with the fret saw blade. If reasonable care is used the pattern produced will not extend into the finished outline.

Another template cut out of tracing paper to the exact finished outline and cemented to the blank allows removal of the excess material with a crochet file in the jig saw. It will be found that the material can be roughed off rapidly without danger of forming a pattern. High accuracy is required only at the points of maximum stress as small errors at remote points will have little effect on this maximum stress. A fairly complicated model may easily be filed out in from one to two hours. After filing to finish outline, the observations should be carried through promptly as drying occurs from the fresh cut edge. Particularly where fine detail is required must this be observed.

It will frequently be found advisable to repolish after the sawing, and sometimes also the finished model. This last should be done with great care and only with the levigated alumina as it is easy to round off the edge, spoiling the model, at the very point which holds the greatest interest. It may also be desirable to smooth down the edge of the model with a wet piece of the 400 grit sandpaper. Holes may be reamed for close fits with dry sandpaper wrapped around a slightly undersize pin.

Before placing the model in the straining frame it is advisable to give it a short polishing at a very light pressure with a freshly cleaned wheel and a drop or two of the levigated alumina. This will remove any grease or finger marks which, at points of close detail, may ruin the pattern. Model should be flushed thoroughly in clean water at model temperature. Any sudden temperature changes are likely to produce a pattern. The model is now ready for loading and analysis.

Before using the polariscope, which is arranged according to *Fig.* 14 and discussed in Part II, it should be cleaned and adjusted. Xylene, a hydrocarbon in the benzene series, will be found suitable for cleaning the disks, quarter-wave plates, and lenses. It should be used sparingly, wiping with soft cleaning tissue. These parts are easily damaged and must be carefully handled. They should not be subjected to a higher temperature than 150 degrees Fahr. Either set of Polaroid disks and plates may be used for polarizer or analyzer.

When the lamp is first turned on the mercury is a liquid and it requires nearly five minutes to heat and thoroughly vaporize it, giving full light intensity. It also requires about five minutes after turning off for the vapor to condense, permitting restriking the arc. Light should be adjusted vertically and axially until, at a distance of several feet from the condensing lenses the illumination is as nearly uniform as possible.

A simple tension specimen will be required for the adjustment of the disks and plates. It may also be used for the calibration of the Bakelite. A suggested design is shown in *Fig.* 15. The width at the midpoint should be as close as possible to central as small errors will make an appreciable departure from uniform

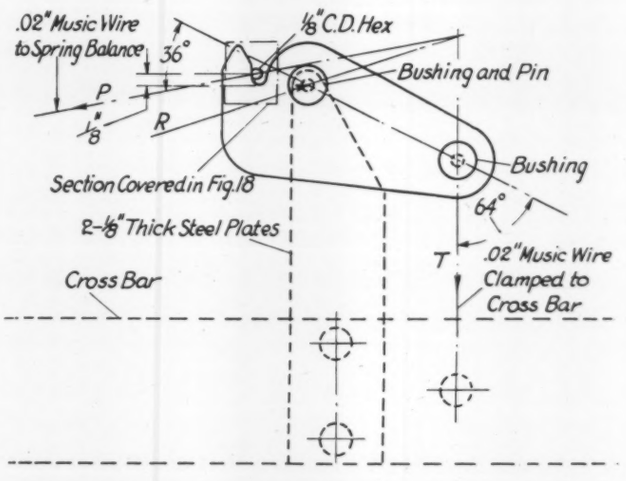


Fig. 17—Example of method of loading a model

stress. (The relative stress difference between one side and the other will be twelve times the relative eccentricity). The steel bushings should be smooth and a free fit in the holes. Polishing need not be perfect as no great detail is required. Specimen is mounted between two plates by means of the steel bushing and pin shown in *Fig.* 15, and the plates are bolted to the lower cross bar of the straining frame. A piece of music wire is passed through the other bushing placed in the other hole, and the wire connected to a 4 to 1 loading beam, somewhat as shown in *Fig.* 16. Specimen should be positioned with its center line vertical and its midpoint close to the center of the field of the polariscope.

With the quarter-wave plates swung out of position, the analyzer disk should be rotated until maximum extinction of light occurs. The two disks now have crossed axes although the actual directions are not known. Then by rotating analyzer 90 degrees, giving maximum light, specimen may be focused on the screen by moving the lens set back and forth. Position of Polaroid disks makes little difference, although some gain in clarity may be obtained by placing them as close to the specimen as possible. Returning the analyzer through 90 degrees to its first position makes specimen (if perfect) practically undiscernible on the screen. There will probably be some brightness however, particularly around the holes.

Adjusting the Polariscope

Applying the load slowly, by means of the spring balance and turnbuckle will show a pattern first around the holes due to stress concentration. As the load is increased the specimen will get brighter and brighter at its midpoint, and then will darken. When maximum darkness is reached it will be stressed, at this point, to the first order. It will probably be found that, due chiefly to eccentricity of the applied load, the darkness does not extend clear across the width.

The load which brings the dark band central about the centerline should be determined and then increased until maximum brightness is again obtained. Dimensions of the specimen are such that the midpoint is far enough removed from the disturbance of the ends to give a substantially uniform distribution of the stress. That is, the stress is simple tension, parallel to the centerline, and equal to the load divided by the cross section area. The principal directions, then, are vertical and horizontal (the centerline was originally set vertical). Since rotation of the polarizer and analyzer together varies the relative inclination of the stress it will vary the brightness of the center part of the specimen.

At the position of maximum darkness the axes will be vertical and horizontal. We will not know which is vertical but will assume it is the polarizer. Mounting ring for one of the disks should be rotated with its pointer around the disk to the vertical (90 degree) reading. Position should be checked as originally described and readjustments made if necessary. Pointer of other disk should be set likewise on the vertical reading by moving around the disk. Now, when these two pointers are set on the vertical positions the polarized beam will be vertical and the analyzed beam horizontal.

Fig. 18—Photoelastic pattern of loaded model section Enlargement is six diameters

Now polarizer and analyzer may be set at the 45 degree position, which will give maximum light at the midpoint of the specimen. If the load is increased until the second order fringe is centered about the centerline and then backed off to one-fourth the distance from the first to the second order, the vertical component emerges from the specimen 1¼ wave length ahead of the horizontal, producing in effect, a quarter-wave plate.

This quarter-wave plate with its known axes, (advancing vertical), is now used to check the apparatus plates. Swinging one of the quarter-wave plates into position it may be rotated until the center of the specimen is at maximum darkness. The retarding axis of this quarter-wave plate must then be vertical in order to cancel the quarter-wave advance occurring in the specimen. By loosening the clamping screws, mounting ring may be rotated around the disk until the pointer is on the horizontal (zero) setting. This position should be checked and readjusted if necessary. The pointer will now be set on the advancing axis of the plate.

Moving the pointer of the adjusted quarter-wave plate to the vertical position, the second plate may then be swung into place and rotated until the field is at maximum darkness (ignoring now the speci-

(*Continued on Page* 102)

Combines Features of Press and T

By Richard L. Templin
Aluminum Company of America

EMBODYING modern hydraulic press design features in conjunction with the latest developments in testing machine load weighing, indicating and recording mechanisms, the machine shown in *Fig.* 1 is a versatile metal working machine which can also be used for testing. Built by the Baldwin-Southwark corporation for the Aluminum Research Laboratories this powerful machine is capable of performing extrusion, forging, forming, rolling operations and has special apparatus for studying the plastic flow of aluminum.

Production presses are generally not equipped with devices which can be used to determine accurately the loads being employed in fabrication processes. These loads have often been determined by measuring the unit pressure developed in the hydraulic system and converting it to total load, but packing friction and many other difficulties make uncertain the evaluation of load by this method. For this reason, the outstanding features of

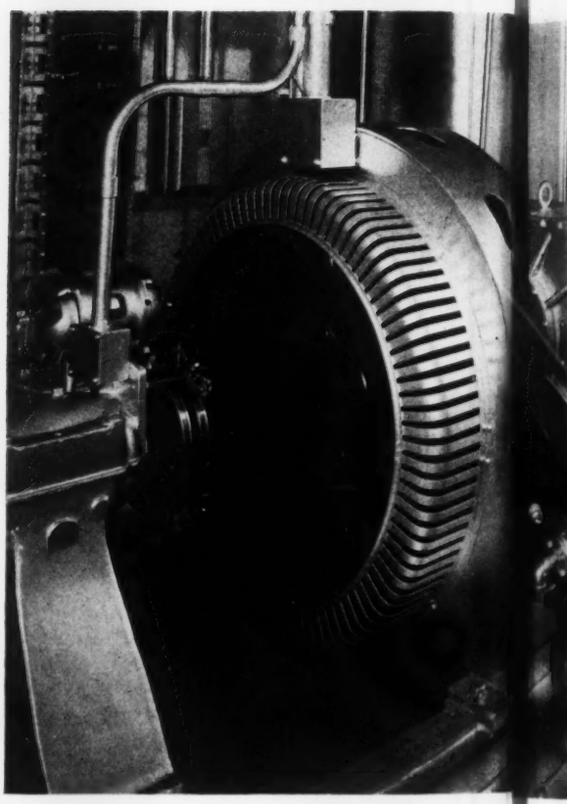
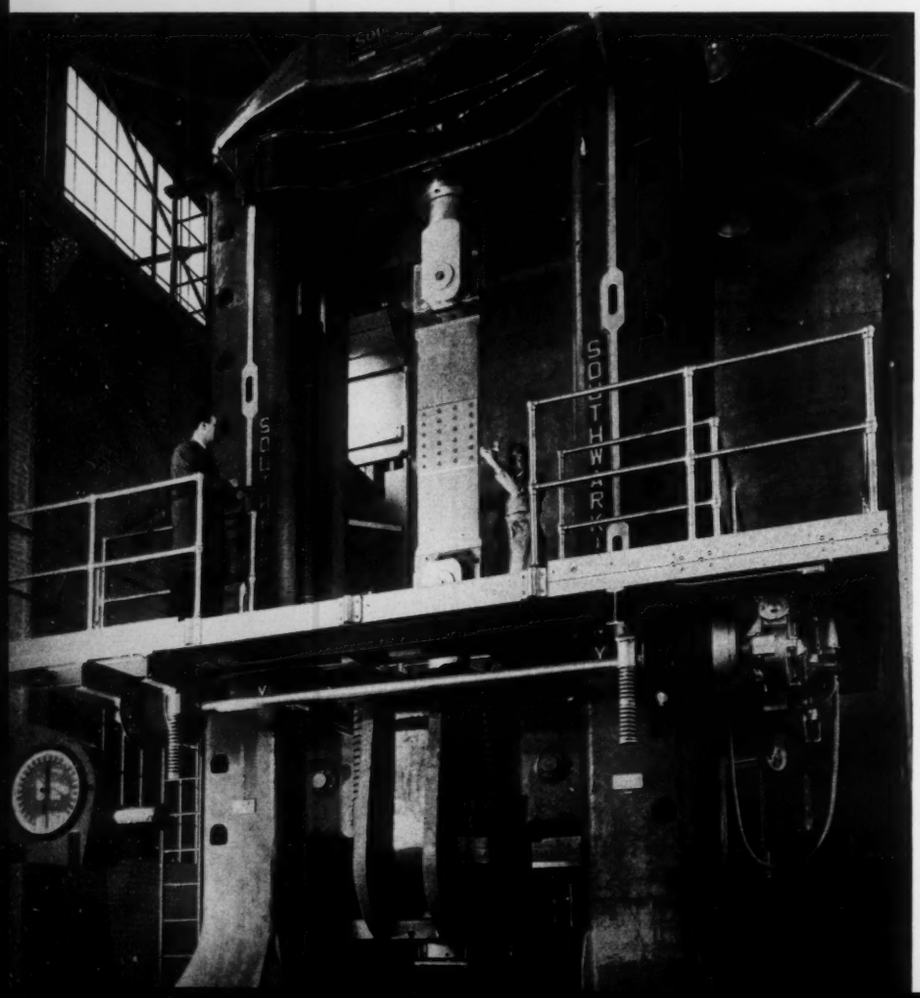


Fig. 1—Precision metal working machine testing joint in tension



a press and a testing machine were combined in the development of this precision machine for carrying out fabrication processes and determining accurately the loads involved.

In effect the machine is a 1500 ton hydraulic press into which has been built an accurate load weighing system which can be employed to measure loads within ± .3 per cent up to the capacity of the machine. As shown in the illustration, the top of the base plate is flush with the floor level. At each end of this plate is a 25-foot high heat-treated cast-steel column, The tops of these columns are tied together by a cap casting.

Partially enclosed by each column a 12-inch diameter loading screw passes downward through the main base plate to the load producing equipment. These screws thread through large nuts located in the ends of the horizontal crosshead

nd Testing Machine

Fig. 2—Hydraulic and mechanical operating equipment located below floor level

of the machine. This crosshead is fundamentally composed of three parts. The horizontal part, through the ends of which the large screws thread, is encircled in a vertical plane by a large yoke. Separating these two parts is an annular hydraulic capsule which is part of the load weighing mechanism. The vertical axis of the crosshead assembly is in the center of a 10-inch diameter hole which runs completely through the head. This hole facilitates the use of certain testing and metal working equipment.

The loading crosshead, which is known as the "sensitive crosshead" because it carries the load weighing capsule is always moved downward to load either in tension or compression. The vertical columns which guide the sensitive crosshead are in compression during tension testing. During compression loading these columns resist horizontal components of forces due to eccentric loads. The sensitive crosshead can be moved throughout the length of the working space of the machine by rotating the screws which thread through its

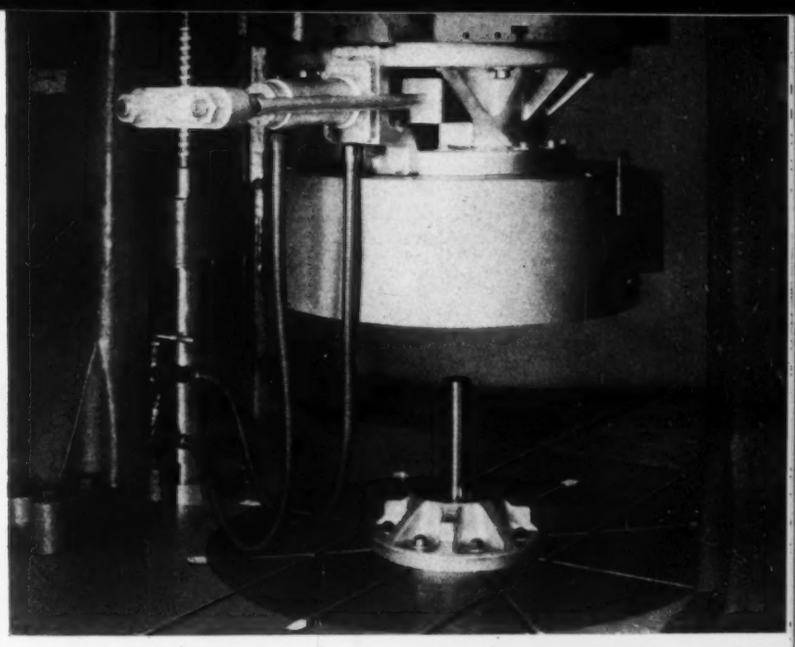


Fig. 3—Experimental extrusion equipment is operated hydraulically and heated electrically

ends. Such movement of the sensitive crosshead is employed only to locate it at the elevation which best suits the specimen or apparatus. Load is applied to whatever equipment is used in the machine by pulling the large screws downward hydraulically.

Completely surrounding the machine, in plan, is an elevator to transport and position observers or apparatus, as in *Fig.* 1, at desired elevations. This elevator is boarded from the ladder which is located at the left side of the machine. Running across the main base plate between the columns are tracks for the industrial railway system to move equipment in and out of the machine. On the cross member of the sensitive crosshead are capstans to which cable slings are attached to facilitate removal of such equipment from the railway cars. In this work, the sensitive crosshead is employed as a 5-ton crane.

Records Loads Automatically

To the left of the machine is the control cabinet, from which station the machine is operated, loads observed and automatically recorded. Pressure developed in the previously mentioned annular hydraulic capsule of the sensitive crosshead is transmitted by flexible tubing to this cabinet where it is converted to load indications on the dials and recorder of the machine. Two such dials are provided, each of which can be used to show two different ranges. The four ranges which are employed are 60,000 pounds, 200,000 pounds, 1,000,000 pounds, and 3,000,000 pounds. Each may be represented by full scale movement of the hands on the 24-inch diameter dials. The load recorder is supported on the right hand side of this control cabinet and on its drum records can be plotted of load against either reduced movement of the sensitive crosshead or elapsed time. The load weighing system used is the well known Tate-Emery design. The control cabinet also houses the electrical and pump controls.

To permit service operations on the hydraulic and

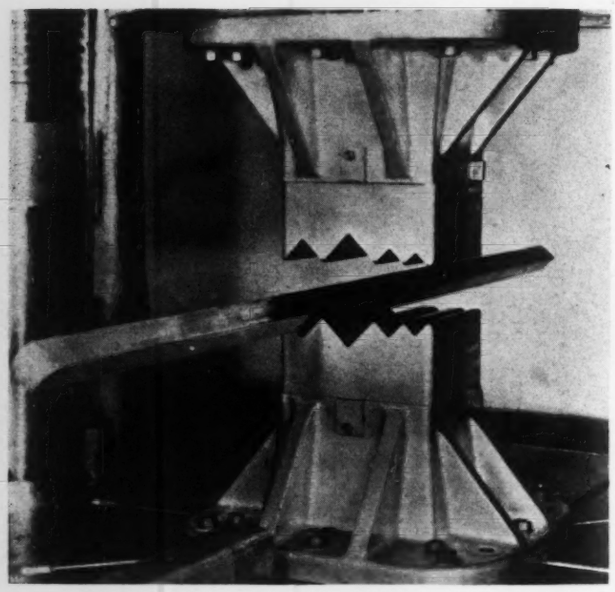


Fig. 4—Press forging equipment to cog square stock. Loads and deformation are recorded automatically

mechanical operating equipment located in the basement below, the aluminum alloy panel floor in front of the machine is removable. *Fig.* 2 shows a part of the operating equipment taken from a position in the basement corresponding to the position on the main floor from which *Fig.* 1 was photographed. In the right background the loading screws can be seen. The main ram, which is 46 inches in diameter, is hollow and is attached rigidly to the under side of the main base plate. Surrounding this ram and open upward is the main cylinder from which extend, right and left, large arms through which the load applying screws pass. The screws may rotate in the bearings at the end of these arms, but longitudinal movement is prevented by large thrust nuts.

Introduction of hydraulic pressure into the cylinder through the hollow ram pushes the cylinder downward. This downward motion is transmitted to the sensitive crosshead through the screws, thus loading the specimen or equipment in the machine. The hydraulic pressure in the cylinder at 3,000,000 pounds load on the specimen or apparatus is approximately 1800 pounds per square inch. Following a loading stroke, the main cylinder, two screws, and sensitive crosshead are returned to their original position by means of two smaller hydraulic cylinders.

To produce the hydraulic pressure necessary to develop the desired loads, two separate pumping units, the pumps of which were made by the Northern Pump Co., are used. Either can be utilized to pump oil under pressure into the main or the pull-back cylinders.

The small pumping unit is similar to those employed in other large testing machines or slow-moving presses. It consists of an 18-gallon per minute variable delivery, radial piston type pump driven by a constant speed, 20-horsepower motor. This pumping unit is capable of moving the sensitive crosshead of the machine at variable rates not exceeding 2.4 inches per minute and to return this head at variable speeds not exceeding 23 inches per minute.

Also a variable delivery, radial piston type pump, the large pumping unit, which appears in the foreground of *Fig.* 2, is driven by a 300-horsepower synchronous motor. This unit permits the application and maintenance of loads up to and including the capacity of the machine at rates not exceeding 36 inches per minute and is one of the unique features of this machine. When this pumping unit is employed it gives combinations of load and speed which distinguish this machine as the most powerful testing machine in the world. The reason for providing such power to this machine is to permit the execution of metal working operations involving large forces and high speeds. In these operations it is also desirable to return the head quickly following a working stroke. The large pumping unit returns the sensitive crosshead at variable speeds up to 288 inches per minute. In both the loading and return strokes, oil is pumped direct into the cylinders. A pressure accumulator is therefore unnecessary.

Although either pumping units may be employed, arrangements have been made whereby the small pumping unit can be used to supply high pressure oil for other uses while the large unit is used to operate the machine. This source of hydraulic pressure is employed in some auxiliary metalworking equipment.

Extrusion Load Recorded

Extrusion equipment, *Fig.* 3, consists of a cylinder assembly attached to the under side of the sensitive crosshead and a ram assembly fixed to the main base plate. The cylinder assembly consists of a three-part cylinder in conjunction with die and locking bar assion presses. The cylinder is surrounded by a 37 kilowatt electric drum-type furnace.

Extrusion as conducted in this machine is accomplished by moving the cylinder assembly downward over the ram. The extrusion billet, which has been previously placed inside the extrusion cylinder, is extruded through the die and upward through the hole provided in the sensitive crosshead. The load which is developed during the extrusion of a billet in this equipment is automatically recorded. This information cannot be easily or accurately obtained in commercial extrusion presses.

Shown in *Fig.* 4 is equipment to press forge metal at different temperatures and rates. This equipment consists primarily of two pedestals, one of which is attached to the main base plate. The other is suspended from the under side of the sensitive crosshead.

While this machine will be used primarily on experimental metal working projects, it can be used also for tensile and compressive tests of large structural specimens.

Plastic Comparator Aids Selection

PRELIMINARY selection of the best plastic for a particular application may be quickly determined from the accompanying chart. In order to bring out distinguishing characteristics the numbers indicate relative values, starting with number one as best. Presented in a paper by C. A. Norris, Bakelite Corp., at a meeting on new developments in molded plastics at the Franklin Institute, this chart reveals the importance of considering not only the most essential property or characteristic required in a molded plastic part but also the necessity of evaluating other properties which affect service.

If color is the paramount consideration, for example, it should not be concluded that the plastic material rated first in color has all the other desirable requirements. Also, if strength is required it should not be assumed that dielectric properties or dimensional stability go with it.

As an example of the use of the chart in selecting the proper material for a given part, an automobile distributor head will serve as a specific example to show how the table works. For toughness, thermoplastic materials together with shock-resistant phenolic are most suited. All the phenolics appear satisfactory for cold flow properties.

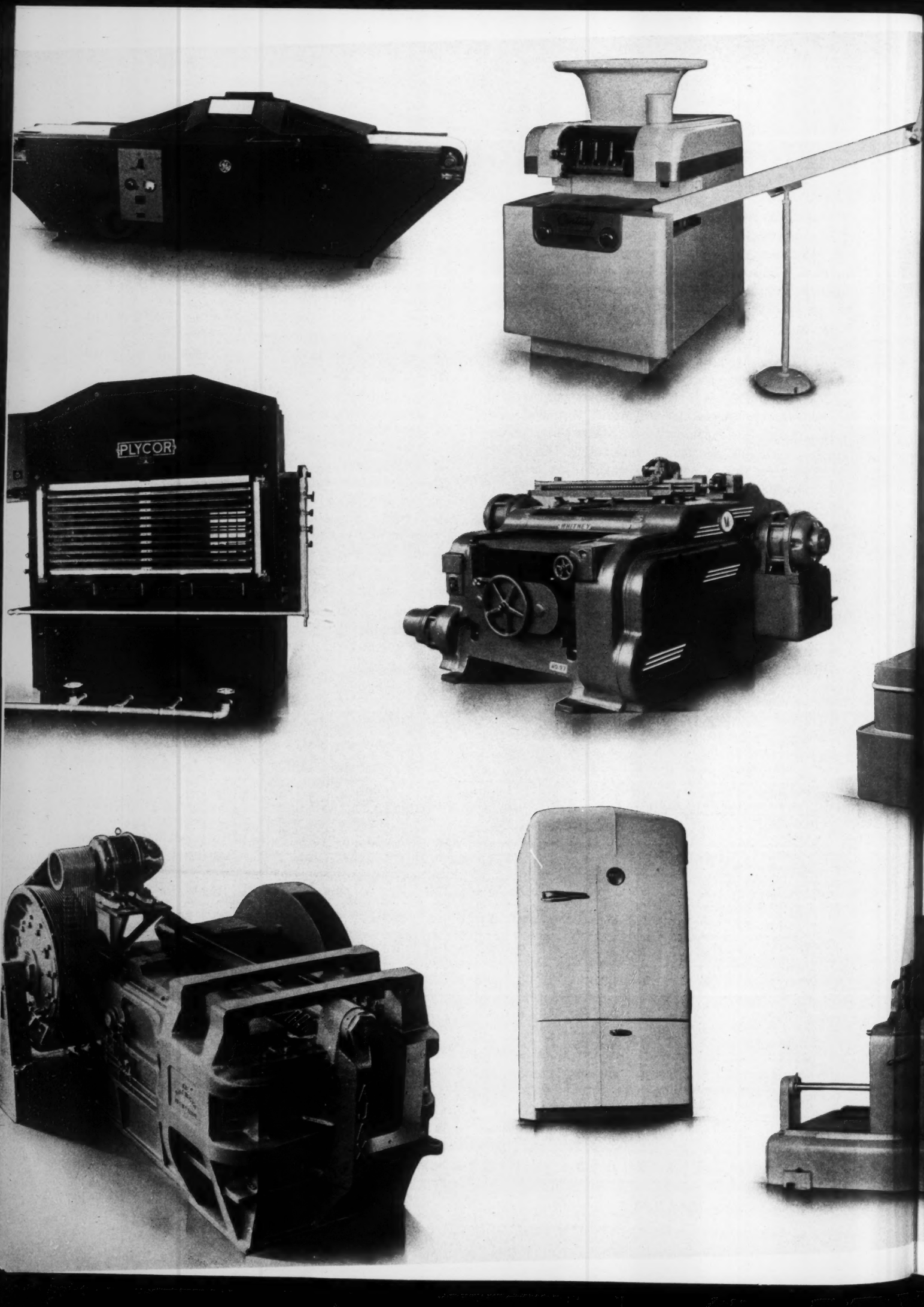
Water resistance needs to be considered for this particular application. Polystyrene is first, vinyl is second and phenolic low-loss and heat-resistant are tied for third. For aging, the following materials are arranged in order of suitability: Heat-resistant phenolic, low-loss phenolic, vinyl. For heat resistance the order is heat-resistant phenolic, general purpose phenolic, low-loss phenolic. Best dielectric strengths are given by urea, polystyrene, methyl-methacrylate. The phenolic materials have an advantage over all others with respect to moldability around inserts.

Cost is also a Factor

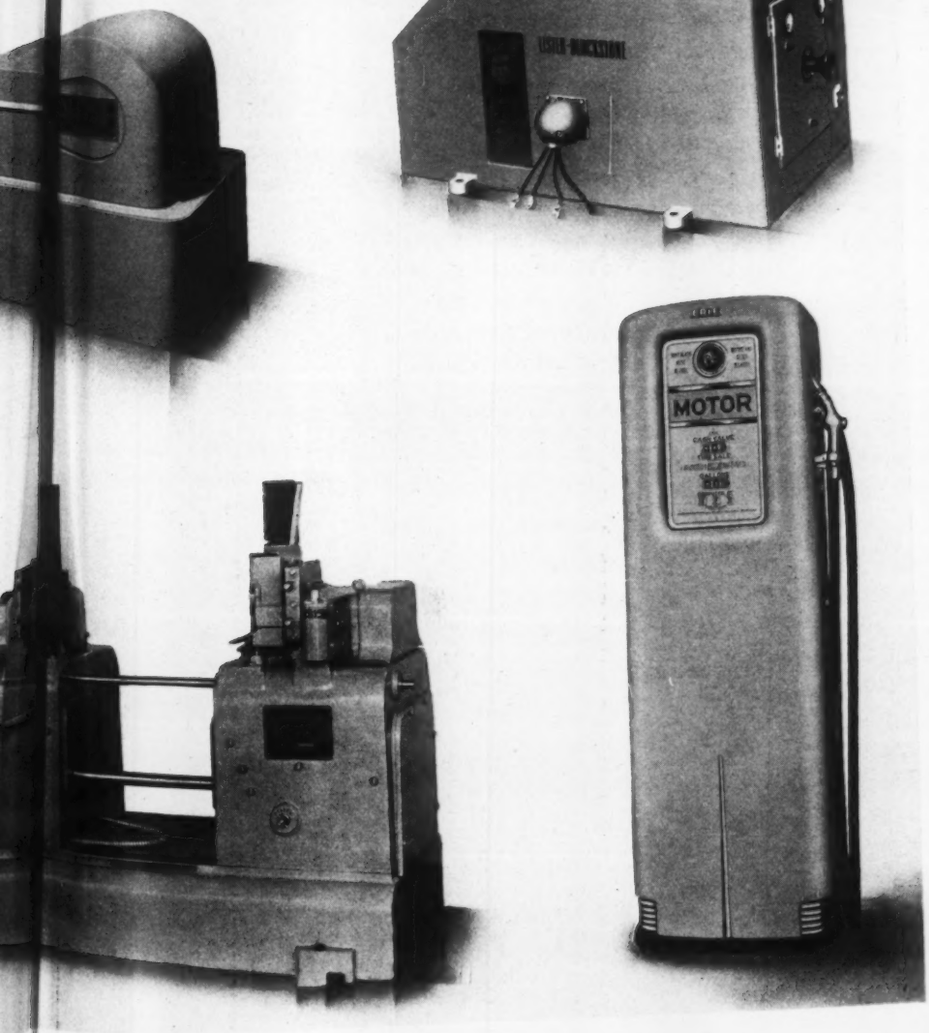
From this survey, it is apparent that low-loss phenolic is best suited for the application in question. This is further supported by actual tests made by one of the large automotive companies. Of course cost is an important factor in selection especially when several plastics may serve the purpose. General purpose material is less expensive than low-loss. While it is not the best material for this job, it is amply suitable and is commonly used.

Thus the table may be used in a similar manner for selecting the proper plastic for any part. It is especially helpful when a combination of properties is involved.

PLASTIC MATERIAL	Toughness (Impact Strength)	Flexural Strength	Tensile Strength	Color	Cold Flow	Water Resistance	Acid Resistance	Caustic Resistance	Solvent Resistance	Dimensional Change on Aging	Heat Resistance	Flammability	Heat Insulation	Specific Gravity	Hardness	Loss Factor	Resistivity	Dielectric Strength	Moldability Around Inserts
Phenolic: General Purpose	10	3	3	7	1	6	3	4	1	4	2	3	2	8	5	10	7	4	1
Phenolic: Low-Loss	8	3	7	7	1	3	4	4	1	2	3	1	7	12	3	4	3	3	1
Phenolic: Heat-Resistant	10	4	8	7	1	3	4	4	1	1	1	1	7	13	2	—	8	8	1
Phenolic: Acid and Alkali-Resistant	11	6	8	7	1	4	2	3	1	5	3	2	2	5	4	—	—	7	2
Phenolic: Shock-Resistant	2	1	5	7	1	7	4	5	1	6	3	4	3	10	5	—	9	8	1
Phenolic: Transparent	7	1	3	7	1	4	2	3	1	5	3	2	2	6	4	7	5	6	2
Urea	9	1	1	1	2	9	4	4	1	7	7	5	5	11	1	9	4	1	3
Polystyrene	7	4	7	5	4	1	1	1	3	3	6	6	1	1	6	1	1	2	5
Cellulose-Acetate	4	6	9	4	8	11	4	6	3	9	5	6	4	7	9	8	6	5	4
Aceto-Butyrate	1	5	10	4	6	8	4	4	3	8	4	6	6	4	8	3	—	—	4
Ethyl-Cellulose	3	2	6	3	7	10	4	2	3	8	5	6	4	2	8	2	2	1	4
Methyl-Methacrylate	6	1	4	2	5	5	2	2	3	8	9	6	2	3	7	5	—	2	5
Vinyl (No Filler)	5	1	2	6	3	2	1	2	2	3	8	6	2	9	7	6	3	1	4


PLYCOR
WHITNEY

Design Features IN NEW MACHINES



THIS MONTH'S COVER. A vibrating feed in the Internationa cigar-making machine assures uniform distribution of all sizes of fille particles to cigars. Filler is fed from hopper to compression chambe and then inserted into a mold in a revolving turret where it is presse into shape. A turntable of two wrapper dies assures increased spee of cutting wrapper leaf. An automatic stop plate at the revolving turre mold stops the machine when any undue pressure is applied

Enclosure of the General Electric visual inspection X-ray unit (left, top is ventilated by a motor-driven fan so that the X-ray unit will operate continuously without overheating. Processed products are inspecte for foreign materials at the belt speed of 50 feet per minute. Moto driving conveyor belt is controlled by pushbutton station operating a magnetic switch with a thermal overload cutout. A corrugated rolle with axis parallel to the belt carries away rejected package

High strength cast iron is used in the rams and the cylinders c the Plycor plywood press (left, center), because required accurac of the plywood panels is so great that pressure tightness must b maintained steadily and wear reduced to the lowest possible min mum. Rams are hardened to approximately 425 brinell

One-piece integral frame without joint between crankshaft an dies provides great longitudinal rigidity in the Ajax eight-inc upset forging machine (left, bottom). Weighing 470,000 pounds the machine is driven by a 150-horsepower motor through V-belt to a flywheel and air clutch assembly. In operation, tripping of small foot valve causes air clutch to engage instantly

Drive of the Century four-pocket divider bakery machine (cente top) is by V-belt worm gear reduction and steel roller chain Reciprocating motions are all operated by a forged steel crank shaft. Oil feeds by gravity to all moving surfaces and surplus filtered into a container in the frame. Dough box is hand scrape

Eight roller bearing, gear-driven feed rolls of the Whitne double planer (center) are controlled by a micro-feed selecto which provides any rate of feed between 30 and 90 feet pe minute. Power comes from a single-speed constant horse power brake motor, permitting instantaneous stopping. Th automatic motor-driven grinder is moved across the bar by separate gearmotor and reverses automatically

Casing of the Philco refrigerator (center, bottom) is so planne that in one piece of drawn steel there are no separate to sides or joints. Thickness of the door is concentrated on th outside to harmonize with the rounded lines and to perm use of a shelf-lined inner door. Styled by Harold Van Dore the refrigerator has a white plastic breakerstrip lining th inner compartment, to blend with other white finishin

All vibrational and torsional stresses between the motor a pump unit have been totally eliminated by the base co struction in the Wallace power pack (right, center). Conste oil change has been made unnecessary by a reservoir co struction providing virtual self-cleaning. Power is tak from the gear type pump through a relief valve with a p determined pressure setting and connected to the unit means of flexible pressure rubber tubing

Wilkin-Challoner automatic plow-bore machine (ri center, bottom) is fitted for single or double boring wood sash, a variable speed unit providing instant chan in feeds from 30 to 60 stiles per minute. An adjusta slip clutch is built into the feed drive to prevent dama in case of jams. All motors are controlled individua from the pushbutton panel mounted conveniently

The Lister-Blackstone "Powr-Pak" diesel-electric pov plant (right, center) consists of a radiator cooled engi generator and control panel, with the generator pla directly beneath the engine, cutting floor space in h Bosch fuel system is used in the four-cycle engine a for engine life cylinder walls are chromium impregna

Dignified simplicity of the Erie gasoline pump (ri bottom) greatly enhances its appearance. The pu was styled by Wilbur Henry Adams and has the lar dial of any machine of its kind. New "piped lightin is featured, an arrangement of plastic tubing encirc the entire dial. Decorative appointments are stainless s

MACHINE DESIGN

Editorial

Photoelastic Analysis Gains Headway as Practical Tool

CHIEF engineers and designers, analytical by nature and training, often are none too receptive toward new engineering department methods and equipment. Furthermore the management of machinery manufacturing companies with which these same designers are associated, are slow to approve the purchase of any equipment of more or less unconventional nature that does not show an immediate return in productive capacity of the company. It is too bad these conditions persist because not only the designer but the company and eventually the public would benefit by a more receptive attitude toward the newer aids to design.

Included in this category is the photoelastic polariscope. Originally recognized only as apparatus for the research laboratory, many years passed before the polariscope was adopted by engineering colleges as being of value for teaching purposes in the study of stresses in machine structures. Not until recent years has photoelasticity gained headway as a practical engineering department tool suitable for use in the direct commercial development of machines.

It is because of the increasing consideration of photoelastic analysis at this time that a wider knowledge of its fundamentals and their practical application is highly desirable. That this fact is well appreciated by MACHINE DESIGN'S readers is borne out by the interest being evinced in the series of articles now being published on the subject, Part III of which appears in this issue. Preparation of the series is based specifically on the actual experience of the author, who has had the opportunity and foresight to put the method to excellent use in his design work.

In the presentation of these articles the highly theoretical aspects of photoelasticity are boiled down to the essentials necessary in giving a clear and concise picture to engineers who have not previously studied this method of stress analysis. The series of articles is complete in itself and discusses only those phases of theory and practice required in successful application.

It is believed that publication of these articles will go far toward bringing to chief engineers and designers in general a realization that photoelastic analysis can be distinctly helpful to them and further that photoelasticity provides an efficient and accurate method of solving those problems that are difficult to handle in other ways.

Professional Viewpoints

MACHINE DESIGN WELCOMES COMMENTS FROM READERS

"... help to change attitude"

To the Editor:

Would you be kind enough to give me permission to reprint your editorial in the March issue of MACHINE DESIGN, "Prestige of Designers Is Enhanced by Public Acclaim." I would like very much to send copies to many in this locality who would not have the opportunity to see the editorial in any other way.

The erroneous idea that machines create unemployment is still more or less rampant in this territory, and I believe that your editorial, distributed in this way, will help to change the attitude somewhat.

On several occasions I have been accused, as one of many in this particular profession, of creating unemployment and I have never seen anything recently as good as your editorial on the subject.

—W. G. MUELLER
Consulting Industrial Engineer

Permission was gladly given.—ED.

"... not taxes on machines"

To the Editor:

If you will glance at the enclosed anonymous communication which has just come to my desk you will get an idea of what you have put me up against by your recent editorial which conveys a thoroughly incorrect interpretation of my recently introduced bill.

You could not have written this editorial had you read any of the statements which I have issued. Curiously enough, in my very first comment upon this proposal I had used exactly the same illustration that you use; namely, the automobile industry and in almost exactly the same way. I said:

> "But while it must be conceded that most of the great modern industries, like the motor car industry, with all the innumerable jobs necessarily brought into existence by them, have been made possible only because men have learned how to invent and to use machines, it is also undeniable that particular men are constantly being displaced by machines. It is not necessary to take either side in the debate as to whether machines in the last analysis create more jobs than they destroy. Machines *do create* new jobs by creating new industries. But, at the same time, they necessarily throw out of employment the particular men who, by the more laborious method, do the work which the new machines perform more efficiently. It is no solace to the steel mill worker who is displaced by a huge automaton that somewhere else the product of the machine is making a new industry. *He is out of a job.*"

We have to take the unemployment problem off the back of the government or business itself will suffer and technological advance will be retarded. You have got to have a market for the products of the farm and of the factory and the only way to provide that market is by stimulating business to provide the jobs which the people need.

Mr. C. F. Kettering of General Motors, talking to the National Press Club one day this week, told his audience how all the paint experts in the General Motors plant resisted his effort to find a more efficient way to paint automobiles and he said, as an expert on technological progress, that you can always depend upon the people most to be benefitted to resist every progressive step.

I think his experience is not unlike my own.

—JOSEPH C. O'MAHONEY
U. S. Senator

The anonymous communication referred to in the first paragraph was a clip sheet of the March editorial on which was notated a criticism of the bill.—ED.

"... is of great interest"

To the Editor:

We believe that MACHINE DESIGN should be in every manufacturer's engineering department, as the information compiled is of great interest to anyone connected with the design of machinery in any particular form.

This magazine is routed through our engineering department and in certain instances is sent to the heads of other departments in the office, who read the articles which have been selected for them by someone in the engineering department.

—A. G. SUTCLIFFE
ILG Electric Ventilating Co.

Men of Machines

KEITH T. DAVIS

HIS ability and knowledge of the increasingly scientific and involved problem of present day heating and air conditioning equipment will be invaluable to Keith T. Davis in his new position as chief engineer of L. J. Mueller Furnace Co., Milwaukee. Mr. Davis was formerly assistant chief engineer of the company.

Graduating with honors from the University of Nebraska as an electrical engineer, he spent a short period in the electrical department at Lincoln, Nebr. of United Light and Power Co., where he had previously worked while in school. He was in charge of development of natural gas load when natural gas was first piped into the Lincoln area. The scientific and practical heating and air conditioning experience and knowledge thus obtained proved a substantial background when he joined the Mueller company in 1937 as assistant chief engineer. He has been actively engaged since that time in developing and improving Mueller equipment.

EDWARD J. CHARLTON

FROM the position of design engineer of Lukenweld Inc., Coatesville, Pa., which he has held since 1931, Edward J. Charlton has been promoted to general manager of the company.

Born in Philadelphia in 1907 Mr. Charlton attended high school there and later Drexel Institute of Technology. His first position after graduation from the institute was with Shepard-Niles Crane & Hoist Corp. in the engineering department of its Philadelphia plant. In May, 1931 he joined the Lukenweld organization as designing engineer and spent several years directly connected with the engineering department. Here he worked on all phases of design development on welded steel structures produced by the company. Following this, he became intimately connected with the development of welded steel structures for railway service such as welded steel underframes for high-speed trains. More recently, however, he has been engaged in sales development work from an engineering standpoint.

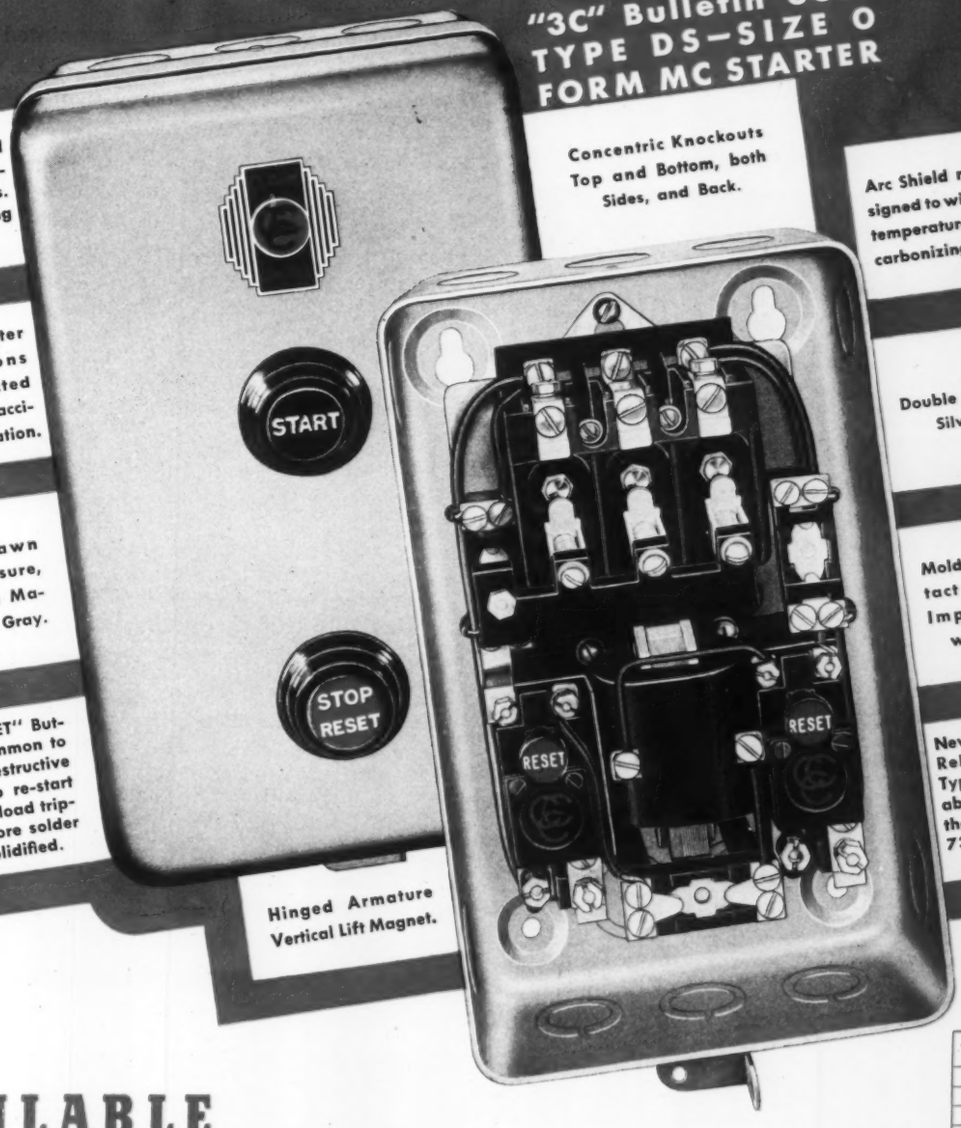
DAVID C. PRINCE

RECEIPT of a new appointment as well as recognition as an outstanding figure in his field brings attention to David C. Prince of Philadelphia who has been named manager of the commercial engineering department of General Electric Co. He recently was selected as one of the "Modern Pioneers of Industry" by the National Association of Manufacturers.

Upon graduation in 1913 from the University of Illinois with B.S. and M.S. degrees in engineering he joined General Electric Co. in its testing department. A year later he was transferred to the railway engineering department. He then left the company for a brief period only to return again in 1919 as assistant to Dr. E. F. W. Alexanderson, then specializing in radio development. Until 1923 he continued this work, when he was assigned to the research laboratory for six years. At this time he was made research engineer of the switchgear department at Philadelphia, and in February

It's New, and All Set to do a Job!

"3C" Bulletin 6013 TYPE DS–SIZE O FORM MC STARTER



Large Electrical and Mechanical Clearances. Plenty of wiring space.

Concentric Knockouts Top and Bottom, both Sides, and Back.

Arc Shield material designed to withstand high temperatures, and is non-carbonizing from arcs.

Large Diameter Push Buttons fully protected to prevent accidental operation.

Double Break Silver to Silver Contacts.

Heavy drawn steel enclosure, finished in Machine Tool Gray.

Molded moving contact holder made of Impact Bakelite to withstand shock.

"STOP-RESET" Buttons are common to prevent destructive attempts to re-start after overload tripping, before solder has solidified.

New Thermal Overload Relay of Solder Pot Type with same desirable characteristics as the very successful Bul. 7322 Thermal Overload Relay.

Hinged Armature Vertical Lift Magnet.

RATING

VOLTS	MAX. H. P.	
	1 PHASE	3 PHASE
110	1	1½
220	1½	2
440	1½	2
550	1½	2

AVAILABLE

Open or enclosed

With normally open or normally closed control circuit contacts.

In single phase or polyphase types.

In Form MC, with "START" and "STOP-RESET" Button in cover.

In Form MA, with Overload Reset Button in cover. Separate Pilot Device required.

In Form MB, with "MANUAL-OFF-AUTOMATIC" Switch and Reset Button in Cover.

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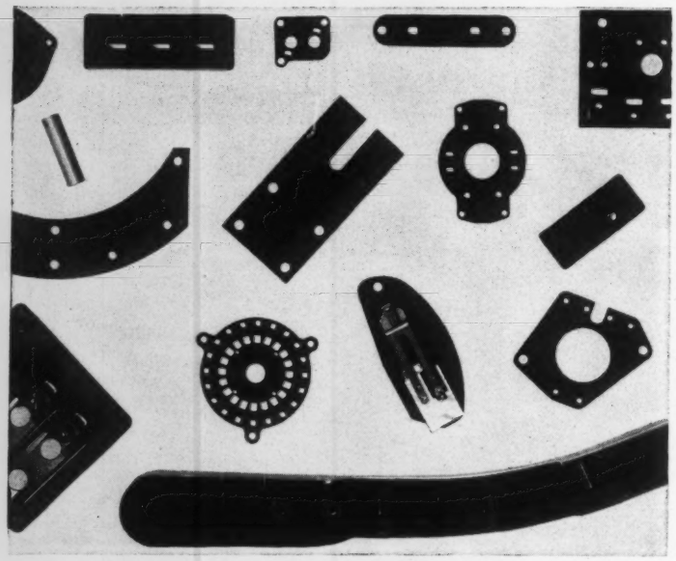

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● Sharp economies in production costs are possible when you entrust your plastics requirements to Richardson. Made to your specifications in close tolerances, INSUROK molded and laminated parts are delivered completely finished—***ready for assembly.*** You'll find it to your advantage to get the facts about Richardson facilities and INSUROK, the precision plastic.

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Melrose Park, (Chicago) Ill. Founded 1858 Lockland, (Cincinnati) Ohio
New Brunswick, N. J. Indianapolis, Ind.
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New York Office 75 West Street, Phone Whitehall 4-4487

1931 became head of the engineering department—the position he occupied until his present promotion. Mr. Prince is the holder of 73 patents and is credited with many valuable contributions to electric ship propulsion, welding, vacuum tubes, mercury arc rectifiers, electric locomotive design and more recently in oil and air breakers including the superspeed breakers built for Boulder Dam.

♦

GEORGE L. SNYDER has been appointed chief engineer of Lukenweld Inc., Coatesville, Pa. Mr. Snyder joined the engineering department of the company in 1935 and two years later became assistant chief engineer, his position previous to his present promotion. Engaged in experimental development and research work for five years, D. BRUCE JOHNSTON has been promoted to manager of development and research. S. NELSON BUELL has been made assistant chief engineer and GEORGE WHEATLEY methods engineer.

♦

D. E. WYMAN, formerly chief engineer, industrial furnace division, Philadelphia Drying Machinery Co., has been named vice president and chief engineer of R-S Products Corp., Philadelphia, manufacturer of heat treating furnaces, burners, gate valves and control equipment.

♦

HUGH M. CORROUGH, who since 1936 has been associated with the Alco Products Division of American Locomotive Co., New York, serving as chief mechanical engineer, assistant manager of engineering and manager of engineering, has been appointed manager of the division.

♦

ROBERT H. HEYER has joined Battelle Memorial institute, Columbus, O. Mr. Heyer was formerly connected with American Rolling Mill Co., Middletown, O., as research metallurgist.

♦

NORMAN W. STORER, retired consulting railway engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been awarded the 1939 Lamme medal of the American Institute of Electrical Engineers "for pioneering development and application of equipment for electric traction." The medal and certificate will be presented Mr. Storer at the annual summer convention of the Institute.

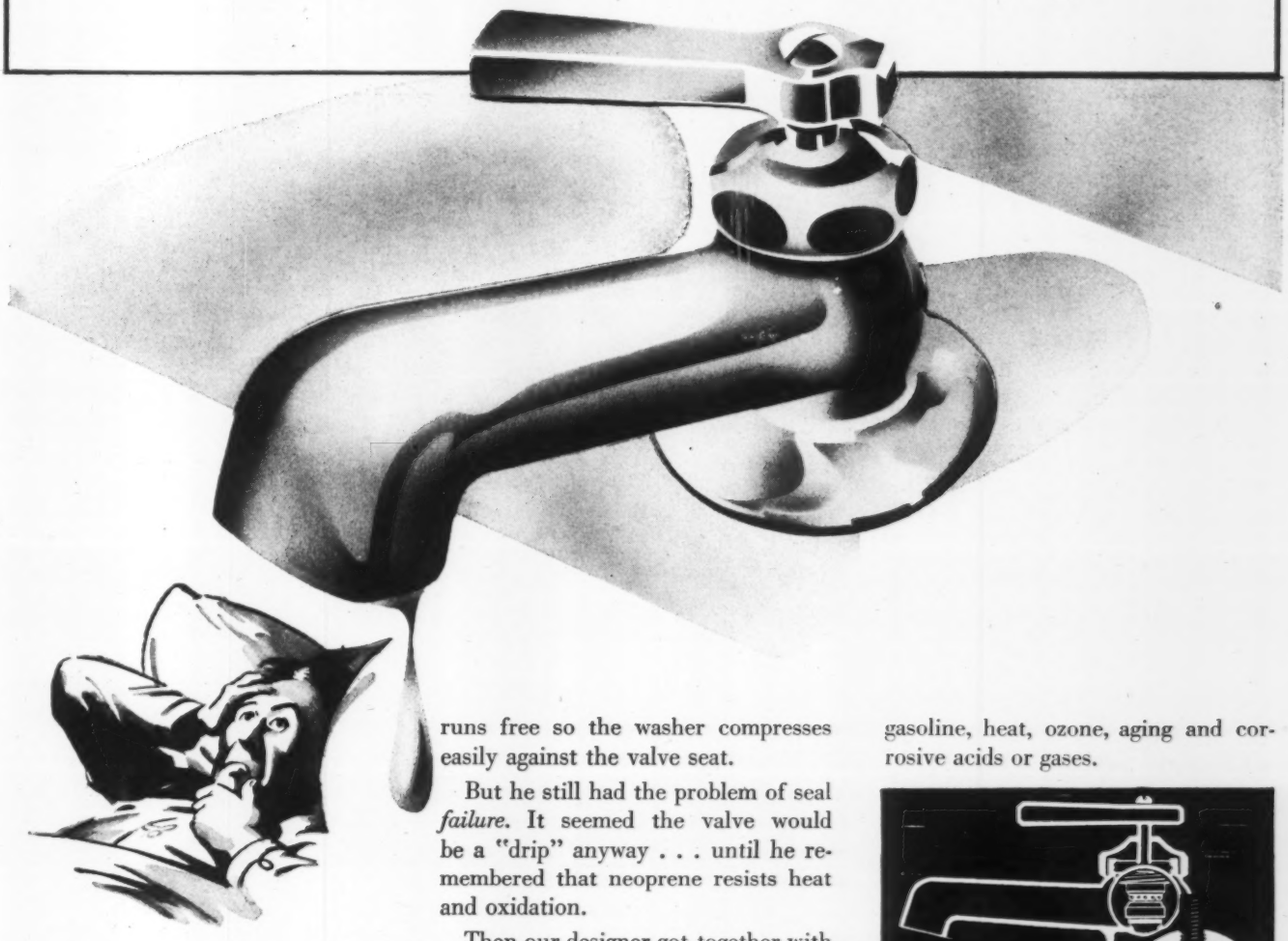
♦

HENRY BOOTH of New York has been elected president of International Acetylene association. Mr. Booth, who was sales manager until his appointment last month as vice president, is connected with Shawinigan Products Corp. of New York. E. L. MILLS, vice president of The Bastian-Blessing Co., Chicago, and prominent in the association's affairs for a number of years having previously served as a director, vice president and president, has been appointed vice president of the association.

THE STORY OF

The Valve that was just a "Drip"

AND HOW THE ENGINEER MADE IT "DRIPLESS"



HE KNEW he should go shut the door. Each drip was like a blow on his head. But the bed was warm . . .

"Is a faucet like the weather," he wondered, pulling the covers up over his ears, "that everyone talks about and no one does anything about?"

And then he wondered why faucet washers fail. Soon he figured out two reasons: (1) rotative wear as the valve turned down to its seat; (2) failure of the sealing material exposed to hot water and oxidation.

"Gotta do something . . ." he murmured and promptly went to sleep.

But next day he *did something!* He took care of rotative wear with a ball-bearing design in which the lower race runs free so the washer compresses easily against the valve seat.

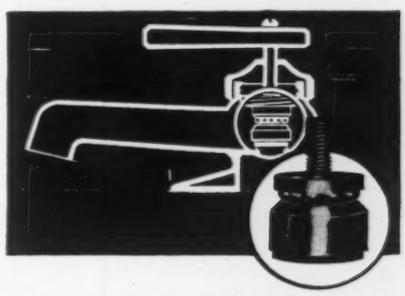
But he still had the problem of seal *failure.* It seemed the valve would be a "drip" anyway . . . until he remembered that neoprene resists heat and oxidation.

Then our designer got together with his rubber supplier and found he could use a neoprene gasket...one that would last.

Now the valve works like a charm. It's "dripless"—compressing to a leak-proof seal. In hot water service it lasts indefinitely. It closes with finger-tip action.

They've found a lot more uses for the valve because the seal is neoprene. It's used on air systems where oil is present, on natural gas systems where sulphuric acid is a problem, and on many chemical lines.

This neoprene is the Du Pont chemical rubber. It has the strength, resilience and toughness of natural rubber. But it is resistant to the effects of oils, gasoline, heat, ozone, aging and corrosive acids or gases.



Do you get *The Neoprene Notebook* regularly? It's packed with news of neoprene uses. Just write to E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Div., Wilmington, Delaware.

DU PONT

NEOPRENE

The Chemical Rubber

Quite a number of factors account for the amazing growth and popularity of the Ozalid process for reproducing technical drawings. Ozalid prints are revolutionary. They are positive, they are clear and contrasty, easily readable, permanent, true to scale, economical. There's another important factor too—the speed, ease and simplicity of the Ozalid machine—the complete mechanization of the process.

The importance of the drive in any mechanism cannot be over-emphasized. On it depend the speed, and accuracy of the machine, the users continued satisfaction.

That's why Ozalid engineers take such pains in selecting the power transmission units. They have tested many. Their final choice is Ohio Gears and Speed Reducers.

You too will find real satisfaction in Ohio Gear Products. Check them for your transmission needs.

Get in touch with the nearest representative for prompt, intelligent service.

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OHIO GEARS

Noteworthy Patents

Centrifugal Governor Controls Mixer

CLOSE speed control and planetary motion of the beater head giving thorough mixing action throughout the entire mixing bowl provide the household food mixer shown in *Fig.* 1 with dependable operation for domestic tasks.

Utilizing a universal series motor, a control device is desirable to keep the operating speeds within limits

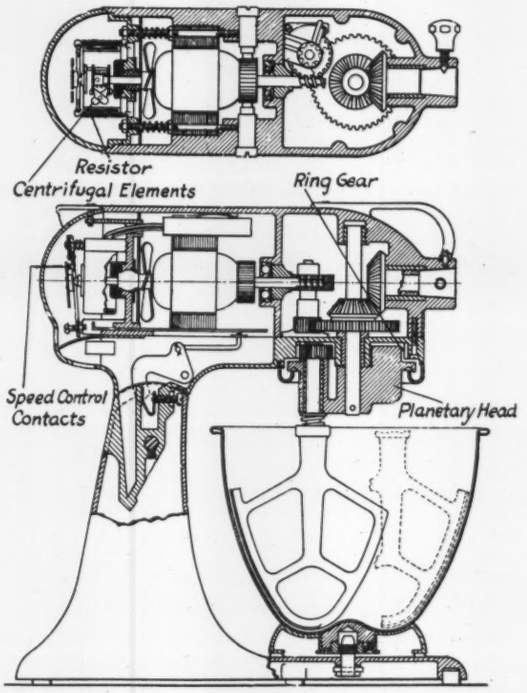


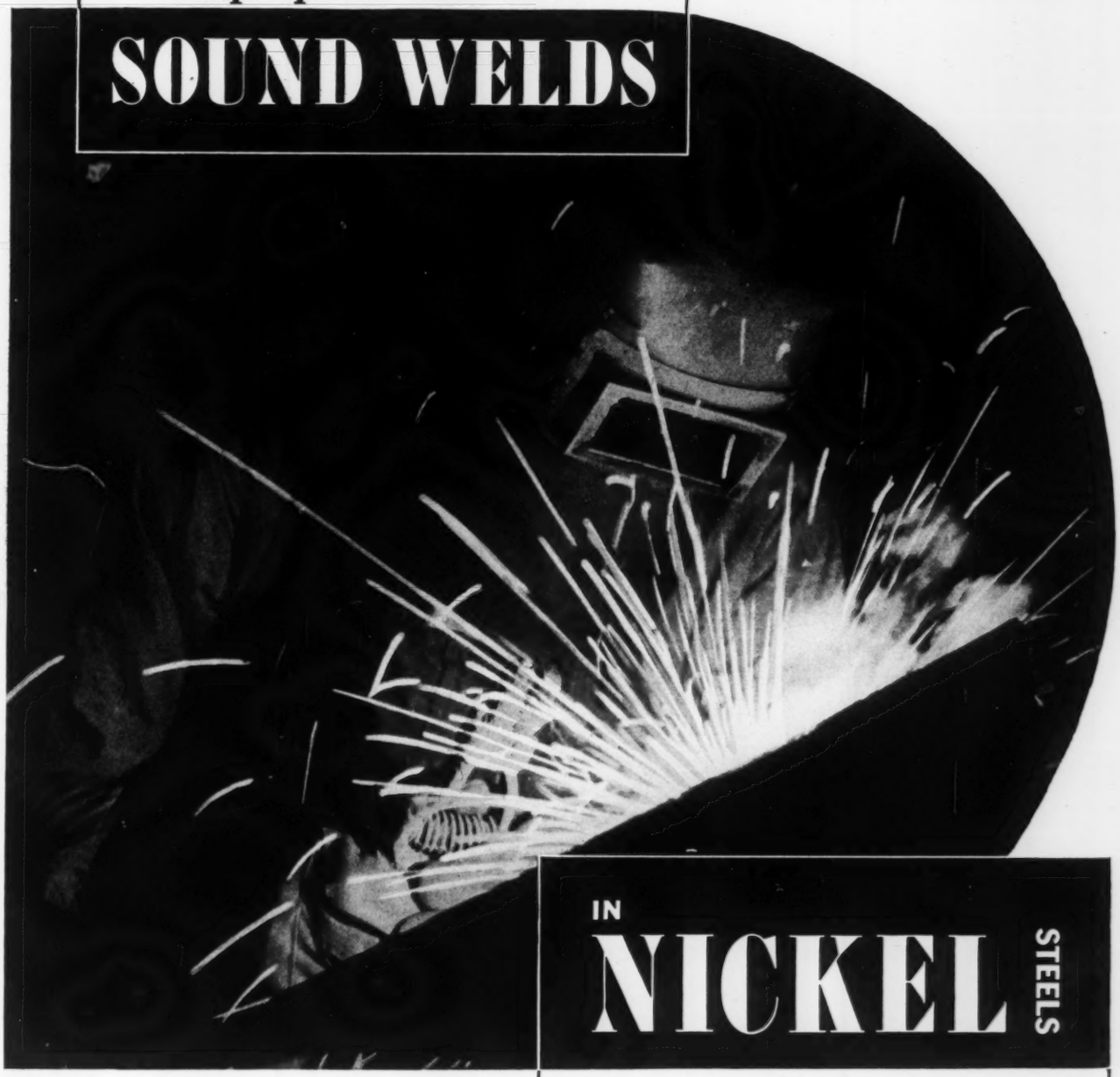
Fig. 1—Proper mixing is assured in domestic unit by speed control and beater design

regardless of the load and variations in its consistency. When speed reaches its maximum centrifugal elements open motor contacts and the motor operates with resistor elements in series with it. Then as the speed returns to normal the contacts again close because less force is exerted by the centrifugal unit, short circuiting the resistors. Speed settings are controlled by a lever which moves the contacts closer or farther apart depending whether slower or faster speeds are desired.

Beater drive is through worm and gear reduction to a secondary set of gears driving a planetary head. Gear on the beater shaft meshes with a ring gear formed integrally with the housing. Thus as the beater revolves it comes progressively in close contact with the entire surface of the mixing bowl to assure a

Simple precautions assure

SOUND WELDS



IN NICKEL STEELS

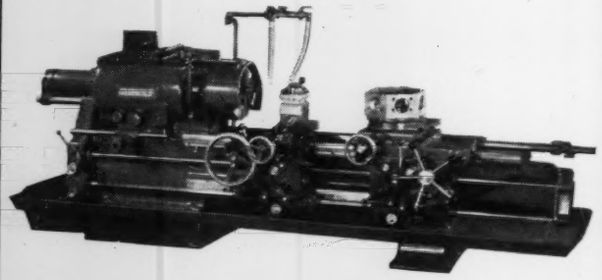
PRODUCING pressure vessels to meet A. S. T. M. specifications, Black, Sivalls & Bryson, Oklahoma City, says, "Provided only that simple necessary precautions are used in fabricating, 2½% Nickel steel pressure vessels can be welded with complete success at the same speed as mild steel, with greatly improved strength, safety and durability in the completed structure." With Murex 2¼% Nickel Steel electrodes, smooth, sound welds are made in 2½" thick 2.00/2.75% Nickel low carbon plates used in fabricating 24' accumulators.

FACTS...*for the asking*

Preheating, stress relieving, tensile strengths, impact resistance, shop practices . . . these important facts about the weldability of Nickel steels are yours for the asking. Simply write for your copies of "Welding Nickel Steels" and "The Working of S. A. E. Nickel Alloy Steels." Consultation on problems involving the use of Nickel is invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

52 LEADING MACHINE TOOL BUILDERS USE AMPCO METAL



For EXTREME SERVICE PARTS

PROVIDING a stubborn resistance to breakage, deformation and wear, Ampco Metal does the job where other metals fail—in parts subject to heavy loading and requiring sustained accuracy—in difficult bearing, nut, gear, guide and insert services.

More and more machine tool builders are changing to Ampco Metal to secure the qualities they have long sought for extreme service bronze parts.

For the complete facts send for engineering data sheets and the Ampco Metal bulletin.

AMPCO METAL, INC.
Dept. MD-5 Milwaukee, Wisconsin

thorough admixture of the contents.

Beater, bowl and head pivot are so designed that the beater may be lifted at any position without interference. Features of this design are covered by patent 2,185,155 issued to David A. Meeker and Russell C. Geiger and assigned to the Hobart Manufacturing Co., Troy, Ohio.

By-pass Fluid Actuates Reducing Valve

TO PROVIDE pressure regulation in an hydraulic fluid system without chatter and in one-third the space usually required are the purposes of the reducing valve design in *Fig.* 2. Covered by patent 2,184,670 issued to Ferris T. Harrington and assigned to Vickers, Inc., Detroit, the valve employs a fluid pressure regulating chamber behind the valve piston, obviating the need of a heavy spring.

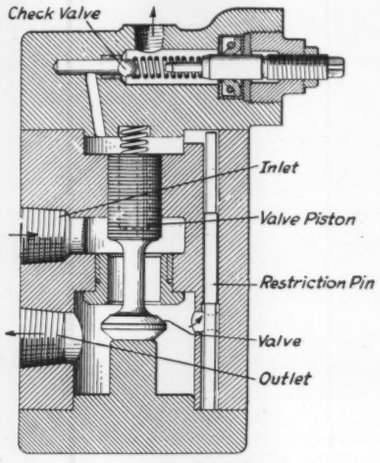


Fig. 2—Design of reducing valve obviates need of large spring for backing valve

In operation, pressure in the chamber above the valve piston is the same as that in the outlet chamber until pressure exceeds the setting of the check valve. At this point the check valve by-passes a sufficient volume to cause a pressure drop. Because interconnecting passage between chambers is restricted by a small clearance pin the pressure drop will move the valve piston upward against its spring, closing the passage between inlet and outlet.

In this position the piston is hydraulically balanced because the exposed seating area is the same as that of the piston plunger. When the pressure in the upper chamber drops below the setting of the pressure control, the fluid flows again through the restricted passage and increases the pressure. Under these conditions the valve opens again.

Thus an equilibrium is established and there is an almost constant leakage through the restricted passage. This slight leakage keeps the pressure from building up in the outlet chamber and also forms a

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leakage load on the top of the piston. Any tendency for the pressure to build up on the chambers is overcome by the check valve and closing action of the piston valve. A smooth-acting reducing valve is thereby provided.

Bellcranks Drive Conveyor

BELLCRANK linkages and compact arrangement of parts provide the shaker conveyor drive in *Fig.* 3 with varying accelerations between forward and return strokes to give maximum jigging movement to the material on the conveyor and yet keep the stresses on the driving parts at a minimum. Designed by William W. Sloane and assigned to Goodman Manufacturing Co., Chicago, this design is covered by patent Re. 21,318.

Motor pinion drives through a gear reducer to

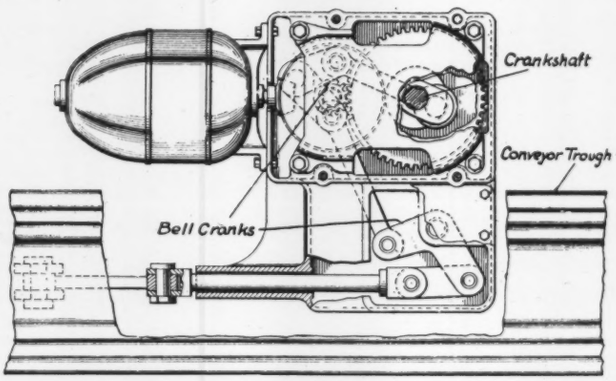

Fig. 3—Bell cranks and linkages are proportioned to impart maximum movement of materials on conveyor but with reduced stresses on drive

crankshaft. This crank is connected through linkages and two bellcranks to the conveyor trough. First bellcrank member is at one side of the extended axis of the connecting link between bellcranks while the axis of the second bellcrank is on the opposite side. This arrangement imparts to the conveyor a forward stroke gradually accelerated for a greater part of its length and rapidly decelerated for the remainder; and a back stroke correspondingly but reversely rapidly accelerated for a relatively short portion of its length and gradually decelerated for the remainder of the cycle.

To move the material along the conveyor the force of acceleration per unit weight on the forward stroke is less than the force of deceleration per unit of weight at the other end of the forward stroke and the force of acceleration on the start of the return stroke. Because the speed of the motor might vary and the coefficient of friction of the materials being conveyed may change markedly, the difference between the forces of acceleration must be sufficient to convey material at all times.

Angles between the lever arms of each bellcrank

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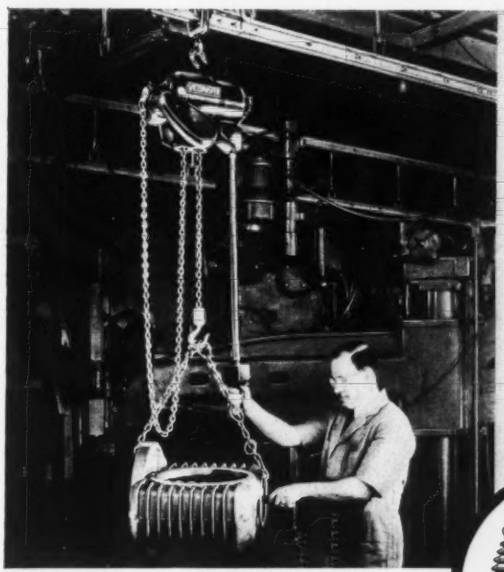
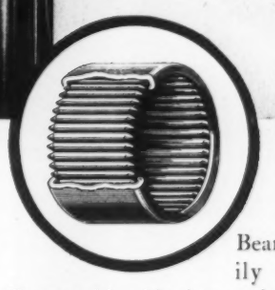
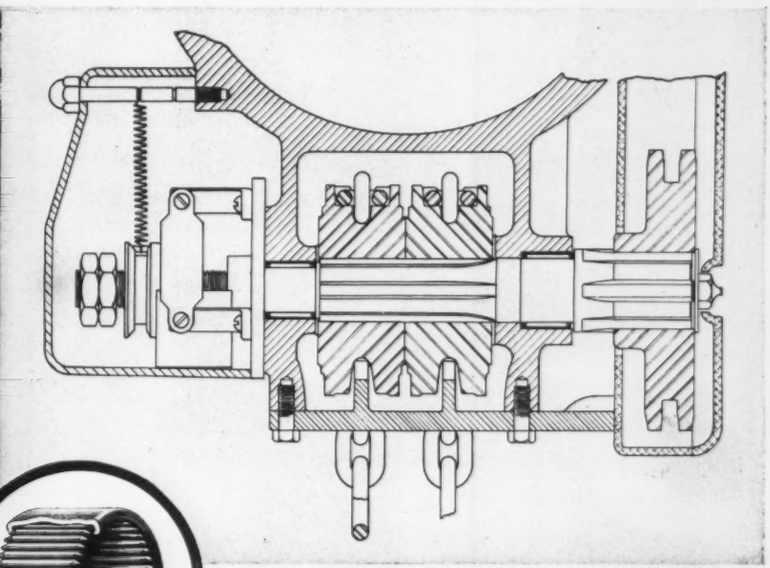


EASY OPERATION, with a reduction in the horsepower required to do the job, is one contribution which Torrington Needle Bearings make to the well-known "SPEEDMASTER" Hoists.





Cross-section view of the point of the load shaft where Needle Bearings are installed. Shows how maximum anti-friction benefits in minimum space can be obtained.

HIGH LOAD CAPACITY—small size for installation in limited space—plus the ability to "take" the brutal punishment of overloading . . . these are the vital requisites of any anti-friction bearing used for the load shaft in the fast and powerful "SPEEDMASTER" Hoists. And in the Torrington Needle Bearing, engineers of The Master Electric Company found exactly the features they specified.

"Not sufficient space for conventional types of anti-friction bearings—yet an anti-friction bearing at the load shaft was vital," says L. G. Knapp, Manager of the Company's Industrial Equipment Division. "For this application, the Torrington Needle Bearing is *ideal*, and has entirely fulfilled the strict requirements imposed upon it."

"Moreover," adds Mr. Knapp, "the use of a Torrington Bearing in this instance has given us the advantage of a reduction in horsepower and has immensely simplified our design and application problem. The Torrington Needle Bearing is readily installed; offers considerable time-saving in assembly; saves on production costs . . . and we are decidedly of the opinion that it presents a distinct step in advanced engineering of hoisting equipment."

Ready adaptability to product designs is an inherent characteristic of Torrington Needle Bearings. Translate these remarkable manufacturing and operating improvements into terms of your own product, and you'll quickly see why so many manufacturers of widely diverse items are fast turning to Torrington Needle Bearings for economies in space, weight and cost. Let the Torrington Engineering Department show you how these and other advantages of the Needle Bearing can be incorporated in your product designs. For further information, write for Catalog No. 9. For Needle Bearings to be used in heavier service, request Booklet 103X, from our associate, Bantam Bearings Corporation, South Bend, Indiana.

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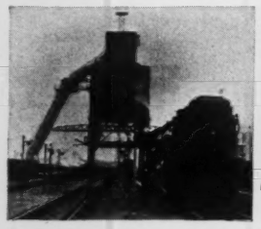
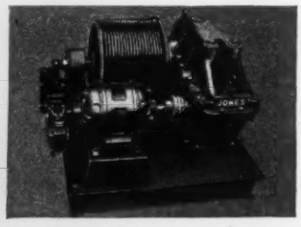
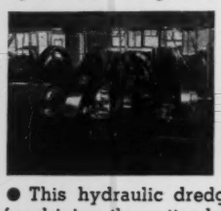




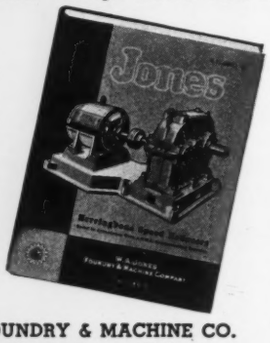
● A locomotive coaling station equipped with a Jones skip hoist unit. These skip hoists are built as complete units by the Jones organization.



● This hydraulic dredge has Jones Herringbone Reducers for driving the cutter head shaft and the drums.

● An oil field pumping unit driven by a special Jones double type Herringbone Reducer through V-Belts from a gas engine.

Both standard and special applications of Herringbone Reducers are covered in this Jones Catalog No. 70. Technical information shows how to select reducers for all conditions of service in accordance with the A.G.M.A. recommended practice.



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member may be changed to have any desired relationship with respect to each other as long as the crank and lever arms maintain the same angular relation. In this way the forces of acceleration and deceleration of the parts occur at the same time and angular movement of the connecting rod is thus reduced to a minimum.

Vacuum Cups Time Dispenser

STOP mechanisms for dispensing devices employing a feeding roll have utilized various devices such as rollers, dash pots, etc. The one illustrated in *Fig.* 4, however, employs vacuum cups in the stop release movement. Patent 2,186,798 issued to Rudolph G. Birr and assigned to Steiner Sales Co., Salt Lake City, Utah, covers the design of this timer.

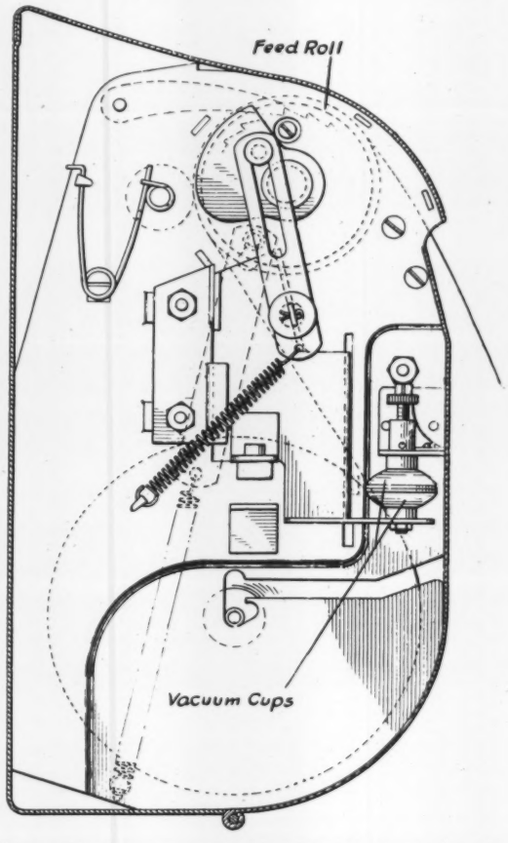
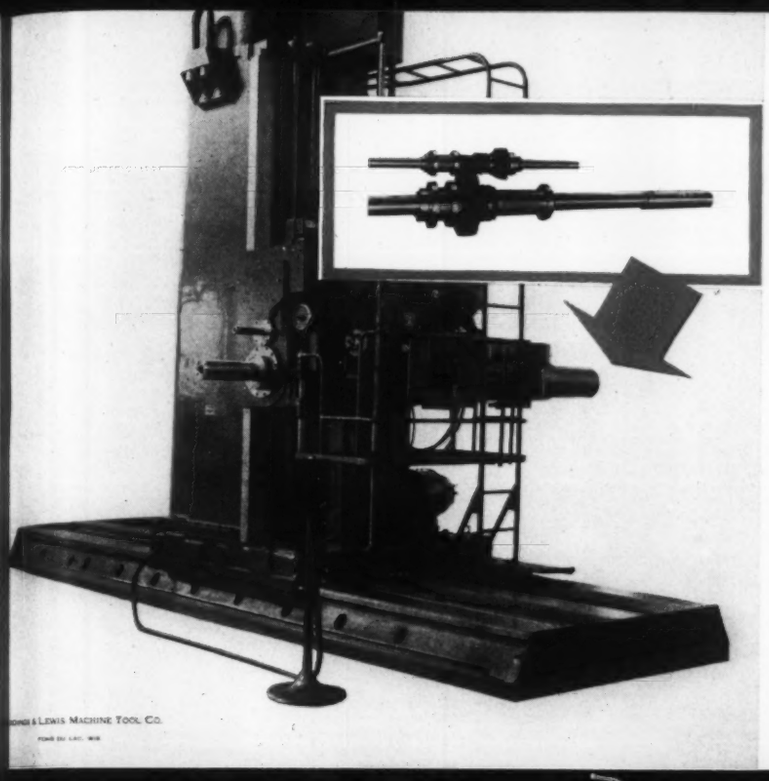


Fig. 4—*Simple stop mechanism controls dispenser by timing operation*

Shown applied to a paper towel dispenser, the feed roll revolves to release a determined amount of towel. Upon revolving, it sets a timing action which prevents further delivery until reset. Cam and slide action, initiated by the feed roll, compresses two vacuum cups and locks the roll until released by vacuum cups. Air admitted to the cups through an adjustable valve releases the lock and sets the timer for the next operation.



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Alloying Elements in Steel

By Edgar C. Bain; published by American Society for Metals, Cleveland; 312 *pages,* 6 *by* 9 *inches, cloth bound; available through* MACHINE DESIGN *for* $4.00 *postpaid.*

A series of five lectures on the functions of the alloying elements in steel, presented to members of the American Society for Metals during the last National Metal Congress, are printed in this volume. Under three general subjects—enhancement of mechanical properties, enhancement of magnetic properties, enhancement of chemical inertness—the more specific material is grouped.

The book does not strictly discuss, however, "alloy steels," although a discussion of such steels is implied by the title. Rather, the objective is "a knowledge of, and if possible, a subsequent classification of, the common alloying elements as to their basic functions in steel—functions which result in property contributions." In other words, it is assumed that the effects of the various elements will remain the same regardless of what name is applied to the steel bearing them. Types of steels discussed include carbon steels, unhardened steels, steel at austenitic temperature, hardened steels, and tempered steels.

Notable about the volume is the way admittedly complex subjects have been made convincingly simple. The book will be a welcome addition to the libraries of designers working with the steels mentioned.

□ □ □

Engineering Physical Metallurgy

By Robert H. Heyer; published by D. Van Nostrand Co. Inc., New York; 6 *by* 9 *inches,* 534 *pages with appendix, cloth bound; available through* MACHINE DESIGN *for* $4.50 *postpaid.*

Primarily a textbook designed to aid those with little acquaintance with engineering metals and alloys, this book nevertheless contains information for engineers with more experience because it treats all its subject matter from the standpoint of how it affects design. It points out, for instance, that "the successful application of a new or improved alloy is not always a simple replacement operation. A modified or an entirely new design may be necessary to effect the greatest gain in utility, lowered cost, or improved appearance."

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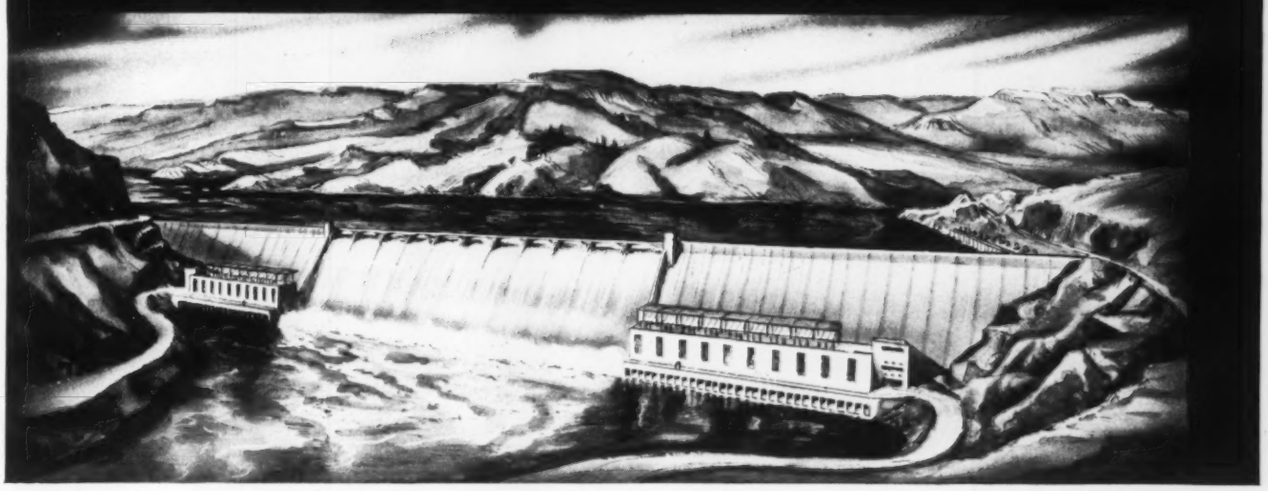

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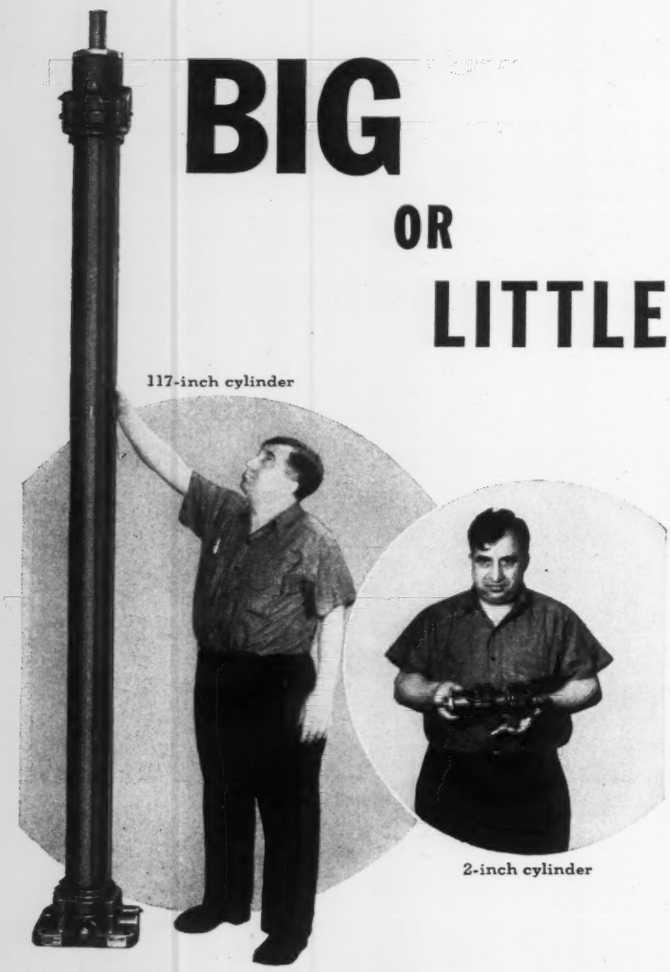

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□ □ □

Procedure Handbook of Arc Welding Design and Practice

Published by the Lincoln Electric Co., Cleveland; 5¾ by 9 inches, 1125 pages with reference data, bound in semiflexible imitation leather; available through MACHINE DESIGN *for* $1.50 *postpaid.*

After two years of additional fact-finding since the last edition, the sixth edition of this handbook has been issued to include all new data essential for most efficient use of arc welding in all its varied applications. The range of subjects covered for the first time is broad and new applications are discussed throughout 35 industrial classifications. In addition, careful attention has been given to the physical make-up of the book, type matter and illustrations having been condensed and arranged to avoid as much waste of space as possible. Through use of better, lighter paper, considerable reduction in size over the fifth edition has resulted, despite inclusion of 25 per cent more material.

Readers of MACHINE DESIGN will find Part VI particularly interesting, since it discusses welded steel construction as it directly affects design of machinery. Subjects covered include advantages of welded fabrication, the design approach, methods of design and shapes available. Case studies of changeovers to welded design and many other examples are given.

□ □ □

Metal Spraying

Revised by E. C. Rollason; published by Charles Griffin & Co. Ltd., London, and distributed in the United States by J. B. Lippincott, Philadelphia; 6 by 9 inches, 218 pages, cloth bound; available through MACHINE DESIGN *for* $7.50 *postpaid.*

Metal spraying demands increased consideration as a means of combatting corrosion, since many metals such as mild steel are subject to corrosion regardless of their composition. This subject, of course, ties in closely with that of applying finishes like paints to metals for protection. The book points out that frequently a coat of sprayed zinc or aluminum will protect steel, and subsequent layers of paint may be applied as circumstances dictate. Designers interested in protective finishes will find the volume a valuable one.

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J. Delmonte, author of PLASTICS IN ENGINEERING, is assistant to the chief engineer of Chicago Flexible Shaft Company (extensive users of plastics), is a member of the staff of the graduate school of Armour Institute of Technology, and has completed considerable practical research in the field of plastics as applied to design of machinery. Mr. Delmonte has contributed many articles to MACHINE DESIGN

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(*Concluded from Page* 46)

to the interior. It was desirable to provide complete covering for the machine, but plant conditions frequently place the pasteurizer quite close to walls or columns which would prevent the use of any type of swinging door. A curved support was provided to carry the upper sidewall weight to the floor and this support established the cross sectional profile of the machine, as *Fig.* 2 shows.

Investigation revealed that a portion of the vertical height of this support provided adequate access to the interior with enough extra distance vertically and on the curve of the support to accommodate a rolling door. Design for the door merely required addition to the sidewall support of tracks for the door rollers. The door itself is made of three hinged sheet steel sections, formed to be self stiffening, with standard ball bearing roller skate wheels carrying the doors along the track. The doors are lifted and lowered by heavy sash chain winding on a long spool of steel tubing driven by a handcrank through a 58 to 1 worm gear reducer. These doors, too, are made in 6-foot 6-inch units and are the same size on every style of machine. All the doors on one side of the machine are lifted or lowered simultaneously by the handcrank.

Top Covers Removable

The upper sidewall jacket extending from the doors to the top of the machine is made in 6-foot 6-inch sections joined together with chromium plated butt straps, and fastenings are self-tapping screws. Top covers are removable lids fabricated of sheet steel on a framework which allows a dead air space between the sheets, and are sized in convenient multiples of machine length and width so that one size of cover is standard for all sizes of pasteurizers.

Quick-opening glass windows are provided on the exterior jacket at each end of the machine to permit observation of the loading and discharge operations. All metal parts of the windows and window frames are chromium plated and fastenings are chromium plated crown nuts.

Possibility of producing wire with a surface-impregnation of dry lubricant for use in applications where lubricant will prevent binding, sticking and wear is forecast by a recent discovery. It was found in drawing fine stainless steel wire, using colloidal graphite as a lubricant, that the graphite particles intimately combined with the surface metal of the wire.

DEEP in the hidden assemblies of these refrigerators . . . where friction, wear, and replacements must be guarded against . . . you will find *Everlock* washers at all critical points.

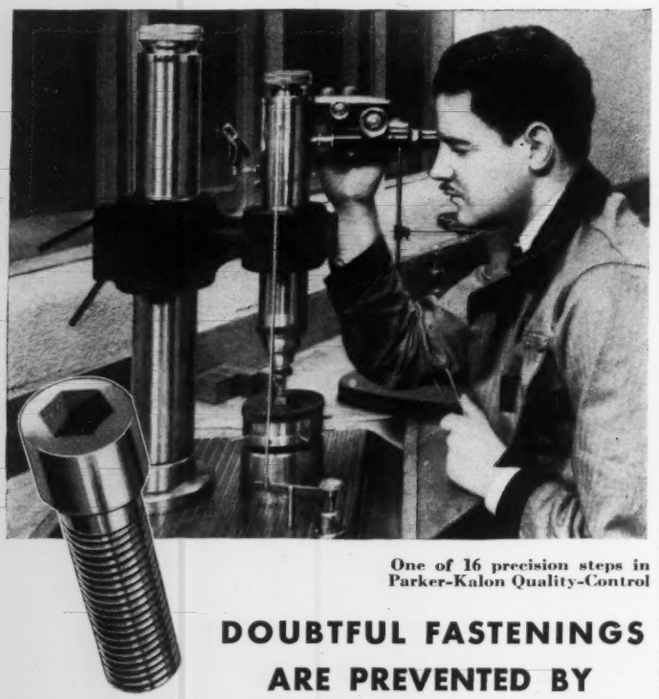
These sturdily-built refrigerators operate economically and efficiently because *Everlock* washers keep vital parts intact! Pictured are three refrigerators and one compression machine, the manufacturers of which used various types of fasteners and methods for holding their machinery parts together before adopting *Everlock* washers.

Today they and other refrigerator manufacturers find that *Everlock* washers do the job more satisfactorily than other types tried out.

Photographs through courtesy of
Kelvinator—Division of Nash-Kelvinator Corp.
Sears, Roebuck & Co.
Servel, Inc.
Stewart-Warner Corp.

THOMPSON-BREMER & CO.
1640 WEST HUBBARD STREET • CHICAGO
Where Other Washers Have Been Tried . . . Now Everlocks Are Specified

16 O.K.'s CERTIFY THESE SOCKET SCREWS



One of 16 precision steps in Parker-Kalon Quality-Control

DOUBTFUL FASTENINGS ARE PREVENTED BY PARKER-KALON QUALITY CONTROL

Unmatched assurance of superior fastening jobs is obtained when your socket screws have been produced under Parker-Kalon Quality-Control. Every screw in a box is guaranteed by a 16-point test-and-inspection routine that eliminates doubtful units . . . screws that might gum-up fastening jobs or fail in service.

Below is an outline of the rigid control routine that is made possible only by Parker-Kalon's $250,000 Quality-Control Laboratory. Read it . . . see why "Quality-Control" means uniformly "better than good enough."

Order Parker-Kalon next time . . . and look for the Quality-Control Guarantee that vouches for this extra quality. For free samples and distributor's name, write Parker-Kalon Corp., 192-200 Varick Street, New York.

Quality-Controlled

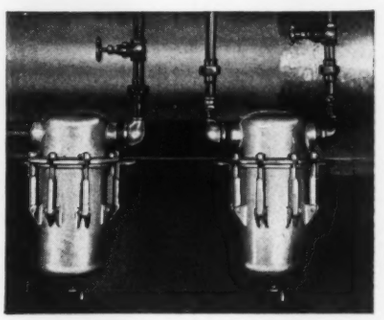
16-point test and inspection routine covers: Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Tension and Shear; Hardness; Head diameter, height and concentricity; Socket shape, size, depth and centricality; Class 3 Fit Threads; Clean-starting Threads.

PARKER-KALON
COLD-FORGED
Socket Screws

New Parts and Materials

Announce High Absorption Air Filter

PRIMARILY designed for complete removal of slightest traces of oil from compressed air lines, model AAPHS air filter is announced by the Staynew Filter Corp., 2 Leighton avenue, Rochester, N. Y. In addition, it effectively prevents the passage of moisture as well as dust, dirt, pipe scale or other foreign matter. Main feature of the new filter is a series of disks possessing a larger absorption area plus unusual filtering efficiency. These disks are made of an exclusive

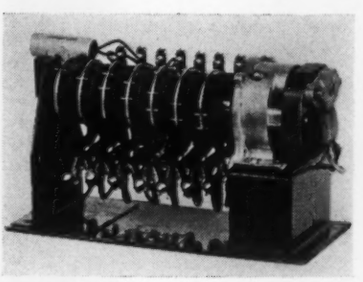


In addition to removing oil completely from compressed air lines, new filter also prevents passage of moisture and dirt

felt-like material, and are carried on a tube composed of an inner liner of perforated metal covered with a fine bronze wire mesh screen. This tube helps to drain oil removed from the air to the bottom of the filter shell. The lower portion of the filter shell is easily removed for inspection or cleaning by simply loosening the nuts on the swing bolts.

Cycles Unlimited in Flashers

MERCURY to mercury contacts sealed in pyrex glass with inert gas eliminate fire hazards, radio interference, burning and sticking of points and frequent contact point renewals in the new line of multiple flashers announced by Emra D. Bacon, 4313 Brooklyn



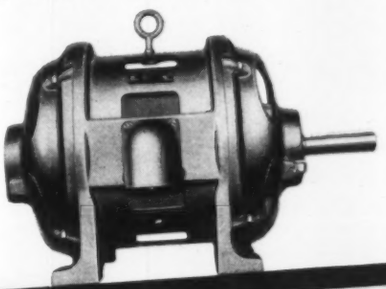
Mercury to mercury contacts are sealed in pyrex, with mercury always visible, in line of multiple flashers

avenue, Cleveland. The mercury is always visible to the eye when in operation. An unlimited range of time cycle adjustment is available, from 1 to 10 time cycles being obtainable from one revolution of the disks or shaft. Each disk is plainly marked in numbers for set-

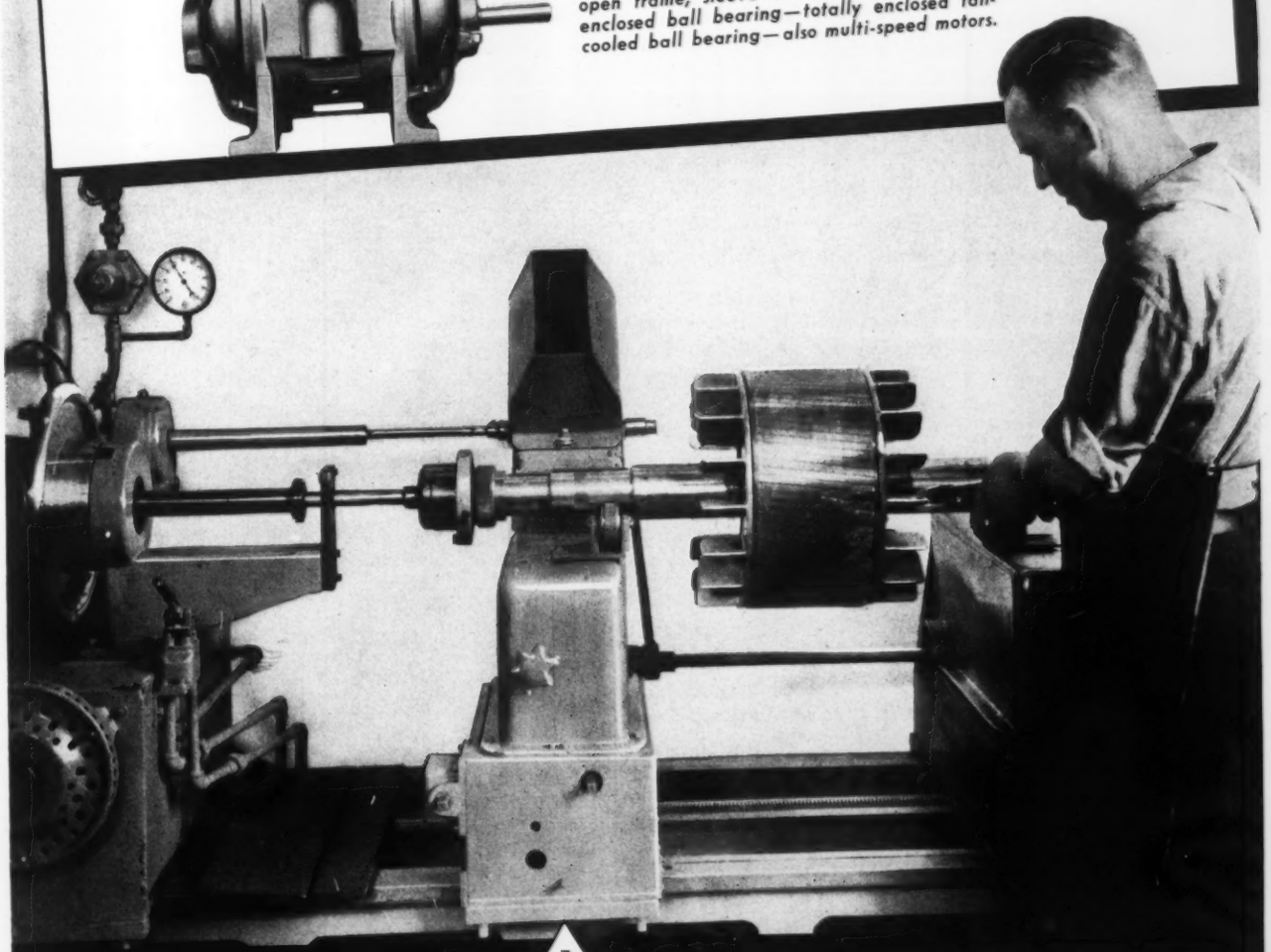
This machine is MORE THAN HUMAN

and it means more satisfaction for Delco Motor Users

The dynamic-balancing machine on which this large rotor is being tested was developed through General Motors' research facilities. Delco Products engineers and General Motors engineers co-operated in designing it. In operation, each end of the rotor and shaft assembly is balanced independently, while two beams of light traveling over a chart indicate how much compensation is required and the exact point at which it must be applied. After adjustments have been made, the complete rotating assembly is again checked as a final test. In bringing the fine art of balancing to a high point in the manufacture of Delco motors, Delco Products performs an important service for motor users. Particularly is this true in view of the modern trend toward individually-driven factory equipment, which puts added emphasis on the advantages of dynamically-balanced Delco motors. Consult the Delco Products Engineering Department for assistance in modernizing your plant operations.

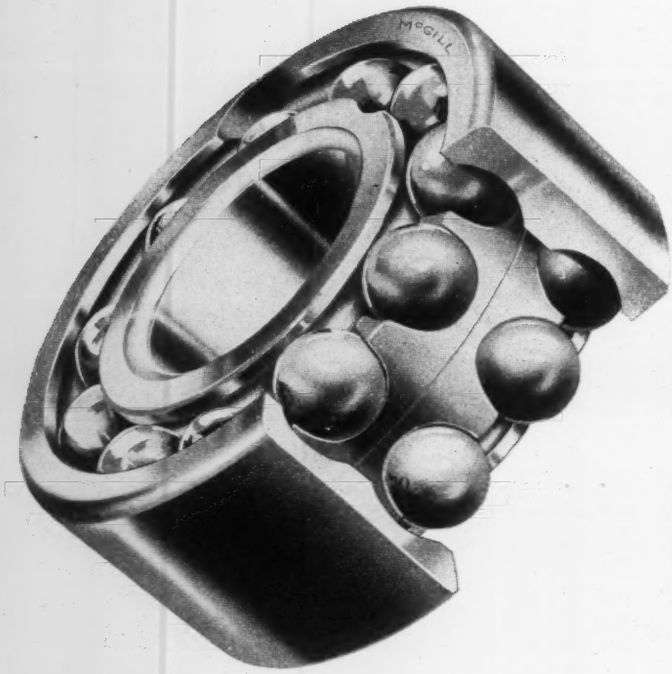


Delco Products industrial A.C. motors are available in various types, possessing electrical and mechanical characteristics to meet practically every requirement. Each type available in open frame, sleeve or ball bearing—totally enclosed ball bearing—totally enclosed fan-cooled ball bearing—also multi-speed motors.



DELCO MOTORS

DIVISION OF GENERAL DELCO PRODUCTS DAYTON, OHIO MOTORS CORPORATION



McGILL . . . MAXIMUM CAPACITY BEARINGS . . . *for greater combined radial and thrust loads*

The greater number and size of balls supporting the races increases load possibilities in the new McGILL Maximum Capacity Double Row Ball Bearing. This new construction is ideally suited for heavy radial or thrust loads or any combination of such loads. Rigidity resulting from angular contact fit-up does not allow race displacement — thus preventing filling notch interference.

Send now for your copy of Bulletin describing this bearing.

. . . with Bronze Retainers

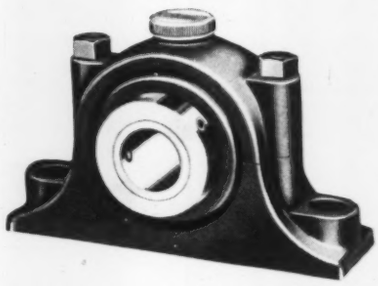
McGILL Bronze Retainers have proven their greater durability and cooler-running qualities through years of use. In this NEW bearing the McGILL Bronze Retainers are in two sections to permit independent rotation of the two rows of balls — important under severe operating conditions.

McGILL MANUFACTURING CO.
1450 N. Lafayette Street
VALPARAISO, INDIANA

ting, and each can be set independently for different time cycles.

Pillow Blocks Simplify Mounting

FOR simplified mounting on ordinary commercial shafting where less heavy loads are to be carried than those requiring the clamp sleeve type of bearing, a new double interlock pillow block is announced by the Dodge Mfg. Corp., Mishawaka, Ind. This pillow block uses a special duplex roller bearing with long extended inner race-ring extending completely through the housing, providing a completely enclosed bearing. Mounting on the shaft is simple. To secure the bearing to the shaft, collars with two setscrews spaced at 120

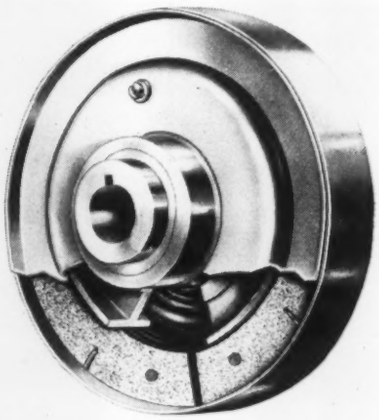


Special duplex roller bearing with long extended inner race-ring is used in new double interlock pillow block

degrees are placed on the outside of each end of the inner race-ring. These screws pass through unthreaded holes in the race-ring, bear directly on the shaft on the one side and clamp the race-ring against the shaft on the other side. Both expansion and nonexpansion types of pillow blocks are available. All normal radial, thrust and shock loads are successfully carried by this pillow block, but load capacity and top speeds may be increased somewhat if bearings are mounted on shafts ground to full size. Adequate labyrinth seals are provided to retain lubricant and to protect bearings against foreign material.

Clutch Assumes Load Gradually

PERMITTING a driving motor to gain speed before assuming load, the new Mercury clutch announced by Mercury Clutch Corp., Massillon, O., is now available in standard sizes of 4 and 4½-inch diameter,



Overloads and other shocks are not transmitted through mercury clutch to prime mover, capacity of clutch limiting torque transmitted

transmitting loads up to 5-horsepower. Other sizes are available on specification. Overloads and other shocks are not transmitted through the clutch to the

MAZLO
Reg. U.S. Pat. Off.

MAGNESIUM ALLOYS

THE LAST WORD IN LIGHTNESS

They're Mazlo Magnesium Forgings

MAZLO makes them all; small forgings weighing only a few ounces and big fellows, like the crankcase-half shown in the above photograph.

MAZLO forgings, because of their high strength-weight ratio, enable you to achieve the ultimate in lightness with safety. The metal is extremely sound. Its endurance limit and yield strength are high.

MAZLO Magnesium Alloys provide a range of physical and fabricating characteristics, enabling you to go *very* light economically. MAZLO manufacturing facilities offer you Magnesium in every form; sand castings, permanent mold and die castings, extruded bar and shapes, sheet, tubing and forgings.

MAZLO

Sales Agent: Aluminum Company of America, 1703 Gulf Bldg., Pittsburgh, Pa.

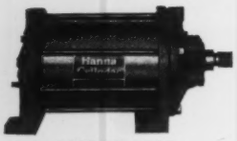
AMERICAN MAGNESIUM CORPORATION

Hanna CYLINDERS

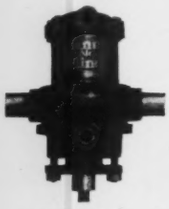
PUSH PULL RAISE LOWER

MODEL 4

MODEL 14



MODEL 4MC



MODEL 17

Hanna Cylinders available in several models to meet mounting requirements.

•

Simple design and extra sturdy construction insures long life and freedom from maintenance worries.

•

Hanna Cylinders furnished with pneumatic adjustable cushions at either end or both ends.

•

Low first cost of Hanna Cylinders offers most economical method of obtaining movement in any direction.

•

Dimensions, capacities and illustrations of all model Hanna Cylinders contained in this catalogue. Enables the designing engineer to incorporate cylinder unit into original layouts. Copy sent upon request.

•

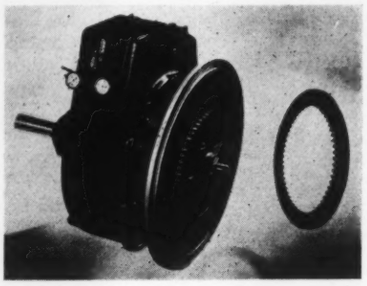
Hanna Engineering Works

1772 ELSTON AVENUE
CHICAGO, ILL.

prime mover, the capacity of the clutch limiting the torque transmitted. Only four principal parts comprise the clutch: Driving member or housing, driven member or inner drum, clutch segments, and the mercury, the latter being introduced or removed through filler holes. In operation, mercury displaces the clutch segments inward, where they engage the drum at the proper time and speed, a positive drive being effected when the speed of the housing and driven drum are synchronized. It is possible to predetermine the time or speed of engagement. Since the clutch gradually picks up the load at full speed, smaller motors may be used when starting under load. Horsepower output per pound weight of the clutch is said to be greater than in any comparable transmission unit. Numerous auxiliary uses have been found for the clutch, including such applications as an automatic brake or a flexible coupling. Inherent features, such as dissipation of heat by the mercury, add to the unit's versatility.

Announce Torque Converter Line

BASED on the Lysholm-Smith system, a line of torque converters is being built by the Twin Disc Clutch Co., Racine, Wis. One of the basic features of this design is the use of a 3-stage turbine which has the effect of producing a high torque multiplication and an efficiency curve with a flat peak extended over a considerable range. The torque increase obtained in the converter is generated as the circulating fluid passes alternately through and reacts against the stages of



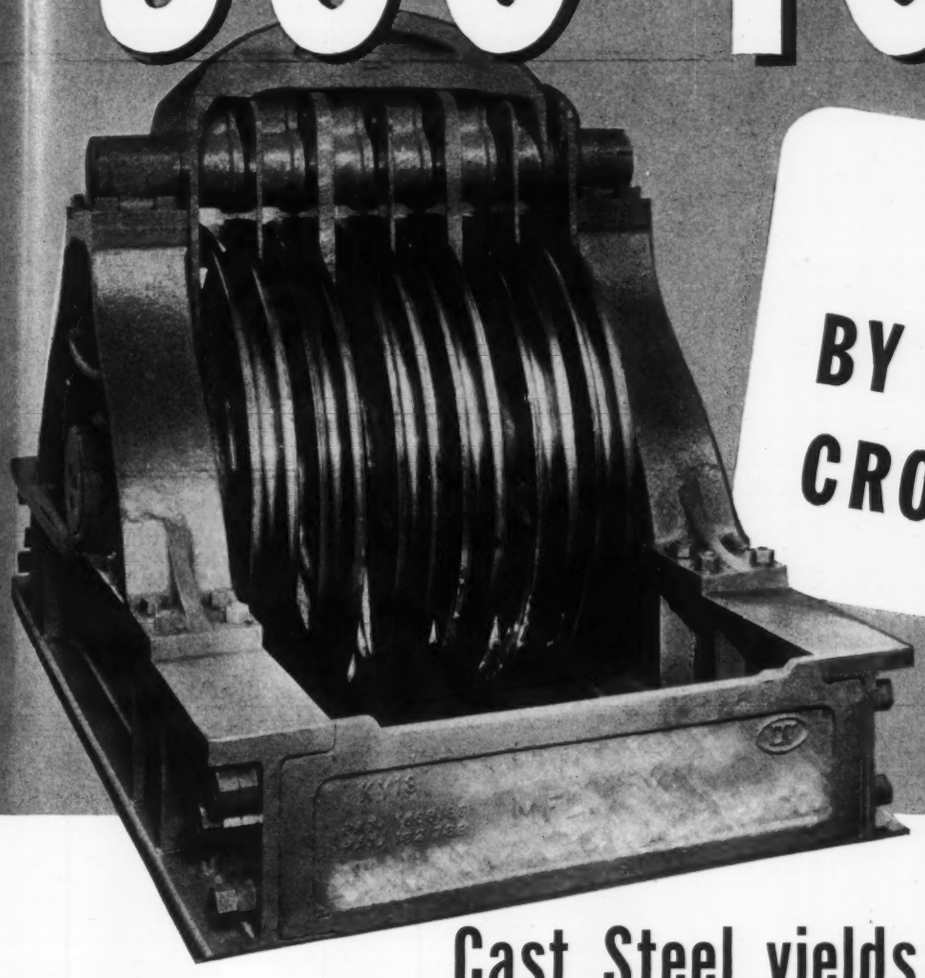
Use of 3-stage turbine features design of line of torque converters based on Lysholm-Smith system

the turbine and stationary blades of the housing. Although the basic hydraulic section of the converter is retained in all models, the balance of the unit with respect to the input and output shaft, etc., is modified in various types for different kinds of service. The plain converter is intended for industrial applications where a continuous hydraulic drive is desirable. Drooping torque characteristics and automatic torque-speed adjustment make this model particularly useful in any service where continuous heavy loads have to be met.

Develop Photoelectric Control Line

A LINE of photoelectric control, designated series No. 60, is announced by United Cinephone Corp., 43 Thirty-third street, Long Island City, N. Y. Rugged telephone type relays are ordinarily provided, permitting a maximum noninductive load of three amperes alternating current at operation speeds up to ten per second. A microswitch carrying eight amperes, or other contacting device handling 15 amperes at 110 volts will fit the same housing, however, and these parts are

360 TONS..



supported
BY CAST STEEL
CROWN BLOCK

Cast Steel yields big advantages in Strength and Cost!

The crown block on an oil derrick must support the entire weight of the drilling tools—often a string of heavy steel tubing 15,000 feet long. And it must also be able to carry an equally heavy string of casing after the well is drilled.

That's why steel castings are so popular throughout the petroleum industry—not only for crown blocks, but for valves, return bends and hundreds of other uses. The greater strength and toughness of steel, plus scientific metal distribution, produce a combination that can really "take it."

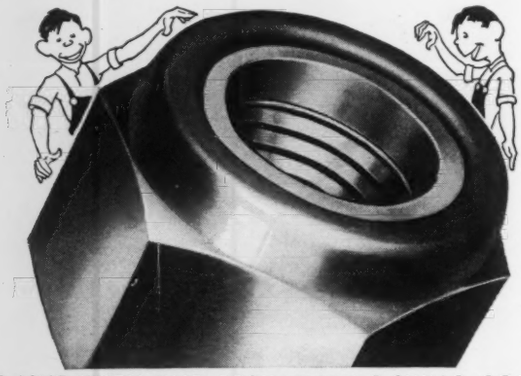
The manufacturer, too, gains through having fewer parts to handle, an easier machining and assembly job, and a wide choice of mechanical properties. All of these mean an improved finished product at lower cost.

Why not consider those definite steel casting advantages for your product? Talk it over with your foundryman, or write to Steel Founders' Society, 920 Midland Building, Cleveland.

MODERNIZE YOUR PRODUCT WITH

STEEL CASTINGS

For **TIGHT FASTENINGS**
...Mechanical and Electrical



THE NUT WITH THE RESILIENT LOCKING COLLAR
Many types... All sizes... All thread systems... Any material

● *Write for 56-page Catalog explaining the Elastic Stop principle and listing more than 700 standard nuts available.*

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1011 NEWARK AVENUE • ELIZABETH, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

THIS NEW BULLETIN CONTAINS OUR FREE TRIAL OFFER

STARTLING FACTS

About a LIMIT SWITCH for Product Design and Electrical Engineers...

IT TELLS WHY
56 makers of Machine Tools and 89 other industries, tested, OK'd and bought

SNAP-LOCK
TRADE MARK
—the rugged switch for all normal circuits

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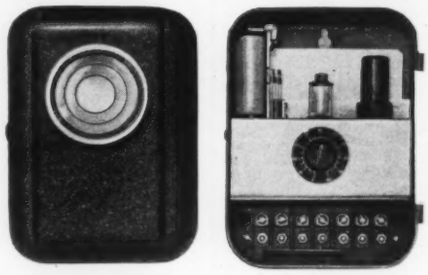
CHRONOLOG DIVISION OF
THE NATIONAL ACME COMPANY
170 East 131st Street • • Cleveland, Ohio

available at slight additional cost. In Model No. 60, the photocell is separately housed, permitting the convenience of mounting the control as much as five feet from the electric eye. Model No. 64 employs a 3-inch collector lens to the photocell for applications demanding response from as little as one-half foot candle with zero residual illumination. All units utilize a commonly available and inexpensive amplifier type tube and

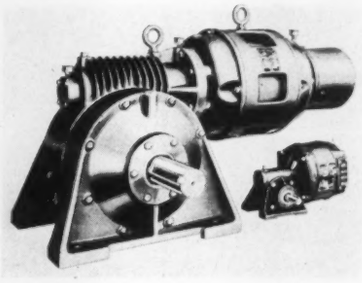


Standard models of new photoelectrical control utilize telephone type relays, although microswitches are available

the photocell tubes have life expectancies of over 10,000 hours. A new line of light sources is also announced, for use with the 60 series of photoelectric controls.

Complete Right-Angle Reducer Line

COMPLETION of the RW style of right-angle worm gear reducers, up to 10-horsepower, is announced by Janette Mfg. Co., 556 West Monroe street, Chicago. Six sizes are included in the line, accompanying illustration showing the smallest and largest. Single reduction worm gears are used, in a gray cast iron housing with unusually heavy mounting feet. Large radiating surfaces are provided for heat dissipation and cooling fins



Six sizes included in line of right-angle worm gear speed reducers with 16 possible mounting positions

are cast integral with the section of the housings enclosing the worms. Single phase, squirrel cage, slip ring and direct current motors are available for driving these units, in ratings from ⅛ to 10 horsepower, with output speeds of from 12.7 to 447 revolutions per minute. Any size RW reducer can be assembled in 16 different mounting positions, making for flexibility.

Shaded-Pole Motors Brought Out

A LINE of ball bearing and self-aligning sleeve bearing shaded-pole motors has been brought out by the Russell Electric Co., 340 West Huron street, Chicago. These motors have high locked rotor and accelerating torque in combination with high electrical efficiency and large output per unit weight. The mechanical system does not depend on the stator for alignment. The latter is accomplished by use of die cast end frames with a

FOUND . . . on Many of America's Best-known Electrical Products-- and for Mighty Good Reasons

G-E ACCESSORY DEVICES

Space doesn't permit detailed discussion of all the illustrated products. Their applications are many and varied. But—these G-E Accessory Devices have proved real helps to an impressive number of appliance designers and manufacturers.

Your product, too, will be well served with G-E Accessory Equipment. Select General Electric Cord Sets, Appliance Switches, Lampholders, Wires and Cables, Heating Elements, Thermostats and Connector Assemblies to help satisfy your customers. *A great many others have found that it pays!*

WRITE, TODAY, FOR INFORMATION

G-E Accessory Equipment Specialists will help you answer your control and wiring problems. Write and suggest that a representative call or ask for detailed information on any of the above product lines. Address Section Q-0615, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC

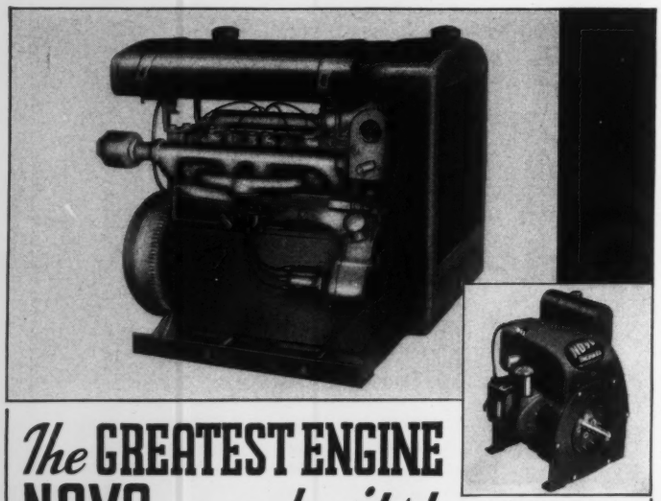
What are your Pump Requirements?

-Tell us your needs!

- We can furnish **Stock Pumps** in a wide variety of types and sizes—Geared - Vane - Centrifugal.
- Also—**Special Pumps** made to your order.

Write—Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN & SHARPE PUMPS



The GREATEST ENGINE NOVO ever built!

Sizes 1½ to 22 HP, 1, 2 & 4 cyl. water- and single cyl. air-cooled

Never before have so many heavy-duty features been built into industrial engines as found in the new Novo Model CW line. They are rugged, heavy-duty units without excessive weight.

HEAVY-DUTY CRANKSHAFT, FLYWHEEL AND ANTI-FRICTION BEARINGS

NOVO ENGINE COMPANY
LANSING, MICHIGAN
278 PORTER STREET

★ Send this coupon NOW for information on the new Novo water- and air-cooled engines.

NAME.....
ADDRESS.....
CITY.....STATE.....

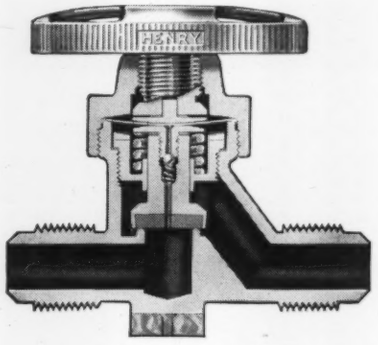
spacer shell held in compression by through bolts. As the illustration shows, this design has a recess in the end frame for the spacer shell and a second recess which positions and locates the stator. These motors

High locked rotor and accelerating torque are features of line of ball bearing and self-aligning sleeve bearing shaded-pole motors

will operate in any position and will withstand substantial end thrust. Power output ranges from three to 15 watts. Alternating current motors are of four-pole design, top speed 1800 revoltions per minute.

Positive Opening Assured in Valves

POSITIVE opening under all pressure conditions is assured by "balancing action" in the new line of diaphragm packless valves announced by the Henry Valve Co., 1019 North Spaulding avenue, Chicago. The diaphragms furnish a perfect seal whether the valve is open or closed. Pressures above and below the seat are equalized at the instant of opening, this balancing action allowing the use of a lighter spring and assuring positive opening at all times. A balancing channel



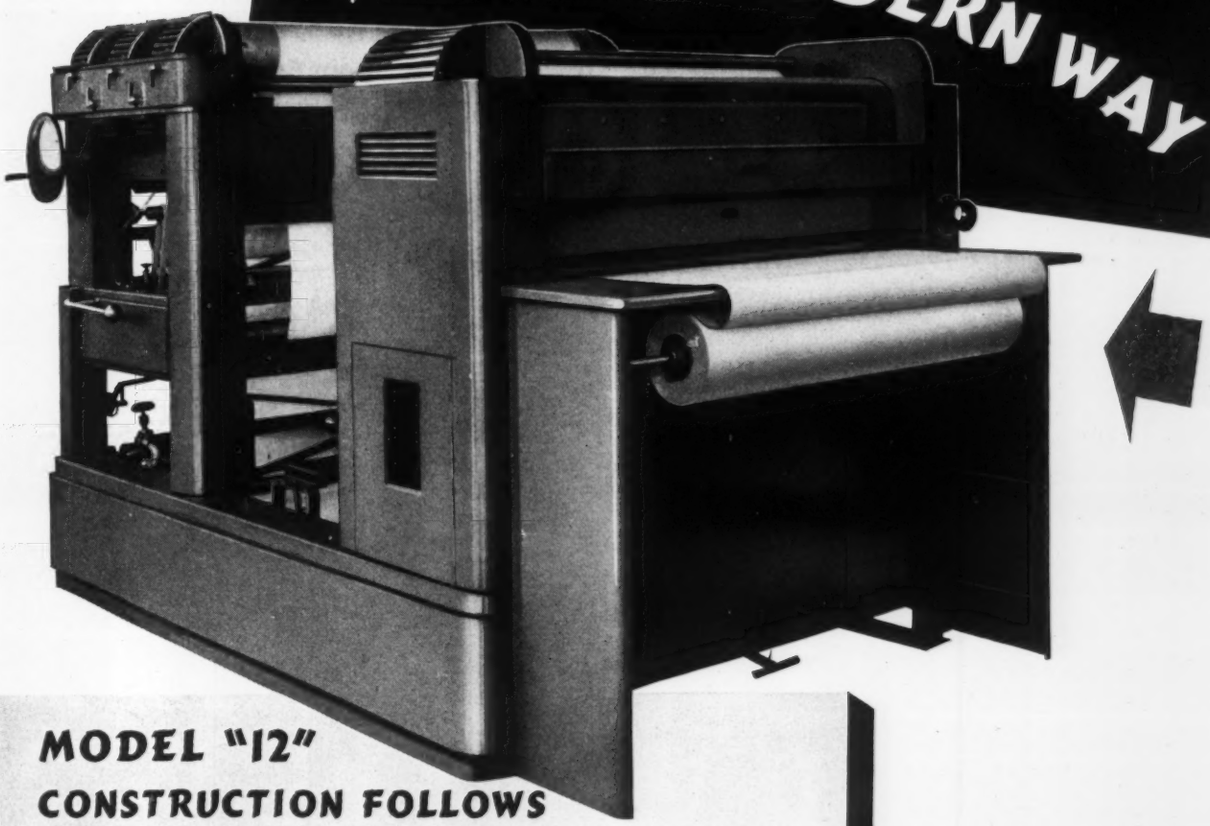
Perfect seal is assured in packless valves by diaphragms, whether valve is open or closed

is provided through the axis of the stem and when the valve is closed, the top port of this channel is sealed by contact with the bottom diaphragm. When the handwheel is turned to open the valve, the diaphragms rise and expose the upper port of the balancing channel, because of pressure beneath them and their own snap action. The high pressure above the seat is instantly released through the channel to the lower pressure area below the seat, equalizing the pressures and allowing the valve to open easily. Inlet and outlet ports of these valves are directly in line.

Variable Transmission Redesigned

A SPEED range of 225 to 925 revolutions per minute when driven by a motor of 1750 revolutions per minute, is provided in the infinitely variable speed transmission just redesigned by Lenney Machine and Mfg. Co., 733 Niles road, Warren, O. Amount of load

MAKE YOUR BLUE PRINTS THE MODERN WAY



MODEL "12" CONSTRUCTION FOLLOWS PRIZE WINNING MODEL "22" DESIGN

When you install a Pease Model "12" or Model "22" Continuous Blue Printing Machine you have a machine which, in the opinion of five competent Judges, leads in "Outstanding Design and Technological Advancement." This modern engineering by Pease brings you the savings you have a right to expect through quality prints produced rapidly at LOW COST PER SQUARE FOOT.

Model "12" Includes 5 Outstanding Features:

1. **Sliding Contact** . . . which permits the greatest possible light utilization.
2. **Patented Lamp Circuit** . . . which permits lamps to burn steadily 45 minutes without break-the arc and resume instantaneously.
3. **Long Horizontal Water Wash** . . . which allows the paper to expand normally without tension wrinkles.
4. **Quick Change Chemical Applicator** . . . which provides a 30 second change-over from Blue Prints to Negatives, or vice versa, and saves chemical.
5. **5 Drying Drums** . . . which thoroughly dry and calendar the prints to a flatness never before achieved.

When you consider these features and realize that Model "12" produces high quality prints at 12 feet per minute, you will understand why the *five Judges chose modern Pease design, and why the new streamlined Pease Continuous Blue Printing Machines provide the most modern reproduction method, as well as the greatest single factor in achieving economy and efficiency in your Blue Printing Department.

*The five Judges for the 1939 Product Design Contest sponsored by Electrical Manufacturing Magazine—names upon request.

THE EMBLEM OF QUALITY IN EVERYTHING FOR BLUE PRINTING

PEASE

THE C. F. PEASE COMPANY

2606 West Irving Park Road . . . Chicago, Illinois

Third of a Series, "How Pease Blue Printing Equipment is Serving the Designing Industry"

LEADERSHIP!

—for contact points and bi-metal

SUNBEAM IRONMASTER relies on WILCO

Synonomous with "dependability"—Sunbeam *must* employ contact materials that are certain to be fail-proof.

No matter what the industry or the application, you'll find the leaders use *Wilco* electrical contacts and *Wilco* thermometals. Why? Simply because in these two specialized fields, there are no hard and fast "rules of thumb." And, there can be no substitute for pioneering research plus years of successful experience. That means Wilco . . . *every time!* The H. A. Wilson Co., 105 Chestnut St., Newark, N. J. Br. Offices: Detroit, Mich., & Chicago, Ill.

WILCO ELECTRICAL CONTACTS

PLATINUM . . . SILVER . . . SPECIAL ALLOYS . . . TUNGSTEN

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Hubert Brueckner

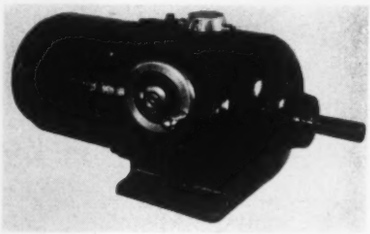
came to Chicago Molded, bringing with him 26 years experience in making precision tools, dies and molds for plastic molding.

Brueckner is but one of some 75 or more men employed in our tool room whose skill and experience is at your service in making precision molds for plastic molding.

We invite your inquiries.

CHICAGO MOLDED PRODUCTS CORPORATION
1028 North Kolmar Ave. Chicago, Illinois

at the output shaft actuates the automatic pressure regulating clutch of simple and rugged design. Quietness is increased and vibration reduced in the bevel gears. Practically all thrust is said to have been elim-



Amount of load at output shaft actuates automatic pressure regulating clutch in redesigned variable speed transmission

inated in the cross shaft and bearings. The speed indicator dial is conveniently located on the top of the machine. Oil is sealed within the case and thorough lubrication is assured by the splash method.

Larger Pillow Block on Market

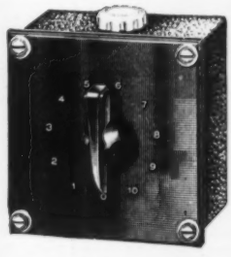
A LARGER one-piece pillow block for shafts of 1-1/16 to 1-5/16 inches has been developed by Randall Graphite Products Corp., 609 West Lake street, Chicago. The entire assembly comprises three parts, the one-

Three parts comprise new and larger pillow block with one-piece steel housing

piece steel housing, a machined cast iron ball with large oil reservoir and a bronze bushing with graphite-filled grooves to provide ample lubrication.

Announce Rotary Selector Switch

AN ENCLOSED rotary selector switch with 11 solid silver contacts, No. 537, is announced by the Shallcross Mfg. Co., 10 Jackson avenue, Collingdale, Pa. It is particularly designed to work as a selector switch in connection with a thermocouple or any other instru-



Selector switch is especially designed for use with a thermocouple or similar instrument

ment circuit where an unusual amount of circuit must be broken in a small switch. Its contact resistance is low. Switch plate is high grade ceramic. When this

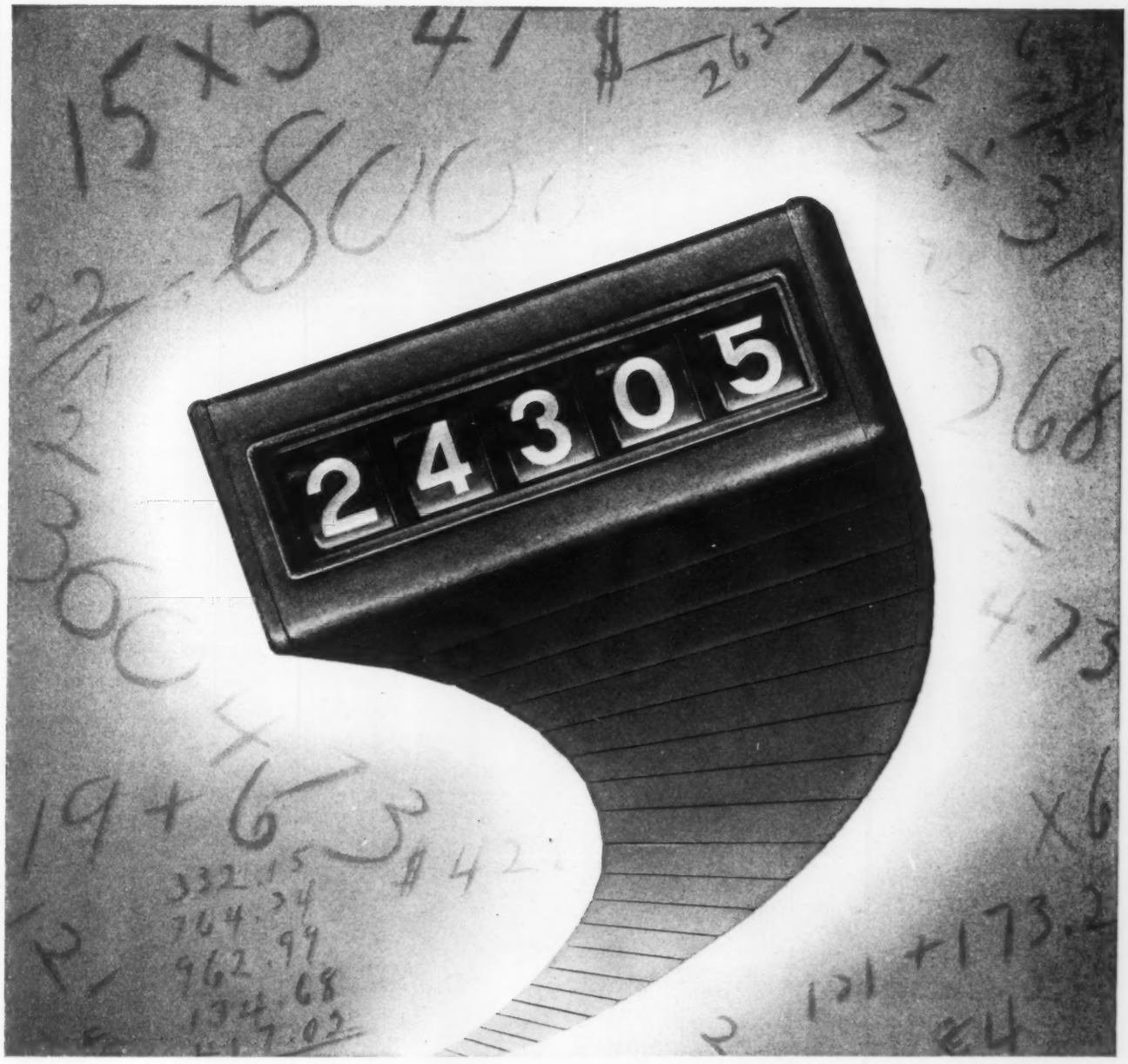


Figure it THIS WAY

Veeder-Root Counting Devices can do a lot of figuring for you. They can supply production totals for machines in your plant—the number of stops, starts or pieces produced. They can give you figures that are important factors in economy or efficiency programs. They can eliminate over-runs or short runs. And in some cases they can actually help to increase sales.

Pumps, presses, tractors, vending devices, elevators and hundreds of other machines have found good practical uses for Veeder-Root Counters and Computers. And Veeder-Root engineers are constantly working with progressive manufacturers—figuring out new devices that will make the products of those manufacturers more useful *and therefore more salable.*

Many interesting case histories of Veeder-Root successful applications are described and illustrated in our booklet "Counting Devices." Write for a copy. You might find it profitable reading.

VEEDER-ROOT Inc.

HARTFORD, CONNECTICUT, U. S. A.

OFFICES IN Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne

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GEARING

— such as these, and numerous others, are the logical product of a skilled organization with a deft 'feel' for *precise* work . . . Note the *Combination* Worm-gear, rotating as a Gear on one side and as a Worm on the opposite side.

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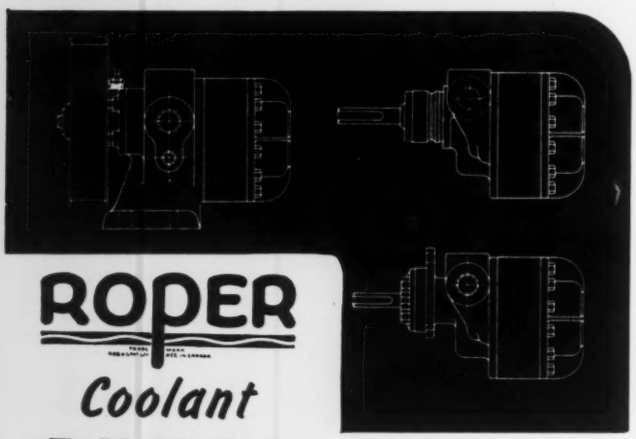


ROPER

Coolant

PUMPS

Hydraulic balance, a feature of the new line of Roper Pumps, equalizes internal pressure at all points and absorbs all shock or thrust from power end of drive shaft.

Now Roper Coolant Pumps are more efficient than ever when applied to machine tools . . . they throw a heavy positive stream, absolutely free from pulsation, with sufficient force to reach the deepest cuts and bores. They work against high or low pressures . . . and do not lose prime.

Get the facts on the new proved Roper line.

Upper Left . . . Foot Mounting with Flanged Drive Pulley.

Upper Right . . . Flange Mounting, Direct Drive.

Lower Right . . . Hub Mounting, Direct Drive.

HYDRAULICALLY BALANCED

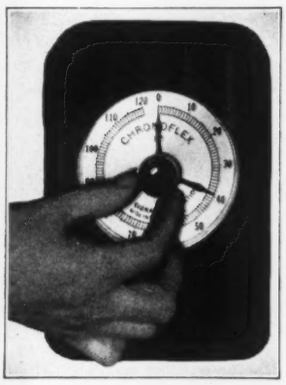
Write for Catalog No. 932

GEO. D. ROPER CORP., ROCKFORD, ILL.

switch is housed in a cast aluminum box and mounted on a beveled plastic panel, it is called the No. 551.

Automatic Reset Timer Announced

SYNCHRONOUS motor-driven, a new Chronoflex fully automatic instantaneous reset timer is announced by Eagle Signal Corp., Moline, Ill. The switch has ⅜-inch diameter silver alloy contacts capable of handling large loads, while the motor used is the slow speed type and uses only 5 watts. At a glance, both the finished and unfinished portions of the time cycle are indicated on the dial. An adjusting knob with a time

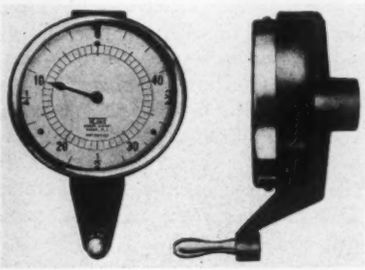


Both finished and unfinished portions of time cycle are indicated on dial of fully automatic reset timer

setting pointer is located directly in front, making it convenient to adjust timing intervals. A powerful solenoid controls a clutch having two disks with rip saw teeth, insuring positive gripping action. The timer can be adjusted for clutch engagement when the solenoid is either energized or de-energized. An attractively styled cabinet encloses the entire assembly. Two standard models are available, one with a cycle range from 0 to 120 seconds, the other from 0 to 20 minutes.

Dial Handwheels Announced

DIAL indicating handwheels for regulating and positioning variable speed drives, distance between rollers, widths of gates, shutters, dampers, etc., are announced by Tejax Engineering Corp., 2 Allens avenue, Providence, R. I. Made for stems or shafts in horizontal



Made for shafts in horizontal position, dial indicating handwheels come in six sizes and models

position, these handwheels come in six sizes and models, No. 5-WC being illustrated. The indicators operate by means of a positive gravity bearing mechanism. The pointer counts the number of turns and the indicator is adjustable in its bracket to compensate for wear.

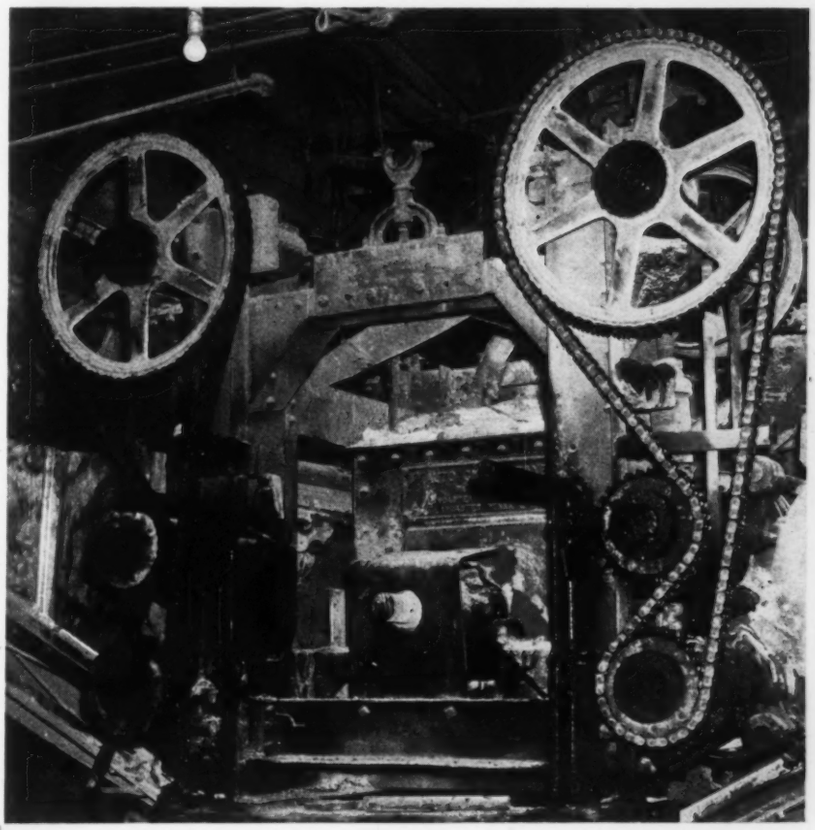
How a New England Brick Plant Solved a Troublesome Problem

● Power transmission drives in brick plants are subjected to heavy clouds of dust and on clay cleaners as illustrated there is the additional problem of driver and driven shafts rotating in opposite directions.

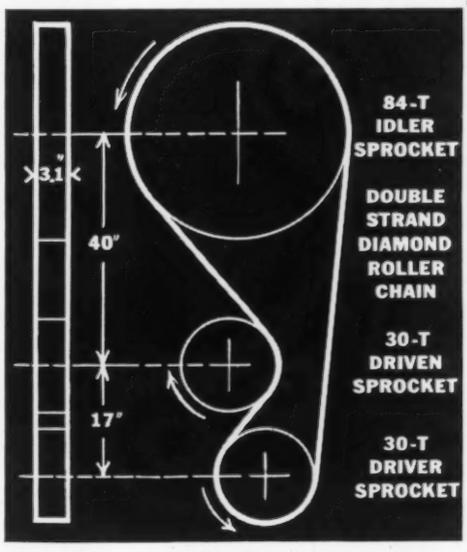
In a New England brick plant the auto clay cleaner drives caused constant trouble and expense. To improve this condition DIAMOND Roller Chains were installed two years ago providing satisfactory operation, steady production at lower cost.

Powdery dust as shown in the photograph has not hampered the performance. Bearing troubles have been eliminated because DIAMOND Chains do not depend on friction—and because the center line of the driving chain being nearer the bearing, there is no tendency to bend the shafts.

Production has been uniformly maintained—expense of replacements and delays reduced.

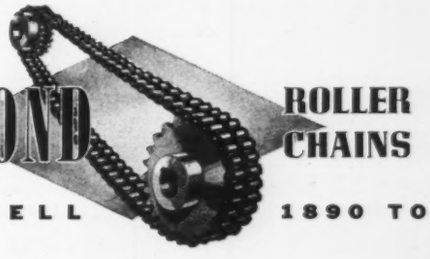


Diamond Roller Chain Drives replaced 14-inch belts on this auto clay cleaner



30 H. P. DIAMOND ROLLER CHAIN DRIVE

You may not operate a brick plant—but the same advantages of DIAMOND Roller Chain drives—high efficiency, positive action, and long life under all operating conditions—can help you to better production at lower cost, too. They are made in pitches from ⅜″ to 2½″ and in single and multiple strands for speeds as high as 4200 r.p.m. Distributors in all parts of the country carry them for prompt delivery. DIAMOND CHAIN & MFG. CO., 435 Kentucky Ave., Indianapolis, Ind.



DIAMOND ROLLER CHAINS

50 YEARS OF DOING ONE JOB WELL 1890 TO 1940

TEXTOLITE LAMINATED

Many designers think of phenol laminated plastics only as electrical insulation. Actually its use in mechanical applications is almost equally extensive.

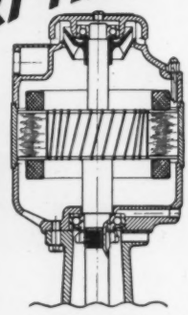
Its many grades offer high specific strength, extraordinary wear and corrosion resistance, dimensional stability, low-cost fabrication and a pleasing feel and appearance.

Write, Plastics Dept., General Electric Co., One Plastics Ave., Pittsfield, Mass.

PD-404

GENERAL ELECTRIC

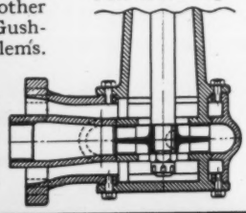
GRIT AND ABRASIVES CAN'T HURT THEM



RUTHMAN GUSHER COOLANT PUMPS

are designed to permit grit and abrasives to pass through them with *no harmful* effects. With split-second control, twin-suction balanced intakes, and many other patented features, Ruthman Gushers will solve your coolant problems.

Patented and Patents Pending



There's a Gusher model to fit your needs. Write for engineering data and specifications

All Gusher models are precision-built, ball-bearing, quiet, and self-cleaning.

THE RUTHMAN MACHINERY CO.
540 E. FRONT ST., CINCINNATI, OHIO
LARGEST EXCLUSIVE BUILDERS OF COOLANT PUMPS

Meetings and Expositions

May 1-3—

American Society of Mechanical Engineers. Spring meeting to be held at Bancroft hotel, Worcester, Mass. C. E. Davies, 29 West Thirty-ninth Street, New York, is secretary.

May 1-3—

Petroleum Industrial Electrical association. Annual meeting and exhibition to be held at Baker hotel, Dallas, Tex. J. F. Collerain, Box 2412, Houston, Texas, is secretary.

May 3-10—

American Foundrymen's association. Annual meeting and exposition to be held at Palmer House, Chicago. C. E. Hoyt, 222 West Adams street, Chicago, is executive vice president.

May 6-8—

Machine Tool Electrification forum. To be held at Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Additional information may be obtained by writing Hendley N. Blackmon, at the Westinghouse company.

May 10—

Electric Hoist Manufacturers association. Annual meeting to be held at Palmer House, Chicago. E. Donald Tolles, 165 Broadway, New York, is secretary.

May 13-14—

Associated Machine Tool Dealers of America. Spring convention to be held at Claridge hotel, Atlantic City. Information may be obtained from headquarters at 505 Arch street, Philadelphia.

May 20-22—

American Gear Manufacturers' association. Annual convention to be held at Grove Park Inn, Asheville, N. C. J. C. McQuiston, 802 Shields building, Wilkinsburg, Pa., is secretary.

May 21-22—

National Metal Trades association. Annual meeting to be held at Biltmore hotel, New York. Harry S. Flynn, 1021 Peoples Gas building, Chicago, is secretary.

May 23—

American Iron & Steel institute. Forty-ninth general meeting to be held at Hotel Waldorf-Astoria, New York. Additional information may be received from the institute's headquarters, 350 Fifth avenue, New York.

May 25—

Golden Gate International exposition to be opened at Treasure Island in San Francisco.

May 27-31—

American Petroleum Institute. Semiannual meeting to be held at Fort Worth, Texas. Lacey Walker, 50 West Fiftieth street, New York, is secretary.

June 3-5—

Scientific Apparatus Makers of America. Annual meeting to be held at Drake hotel, Chicago. J. M. Roberts, Room 3104, 20 North Wacker drive, Chicago, is president.

June 6—

Automobile Manufacturers association. Annual meeting to be held in Detroit. Byron C. Foy, New Center building, Detroit, is secretary.

June 7-8—

Stoker Manufacturers association. Annual meeting to be held at Hot Springs, Va. Marc G. Bluth, 307 North Michigan avenue, Chicago, is secretary.

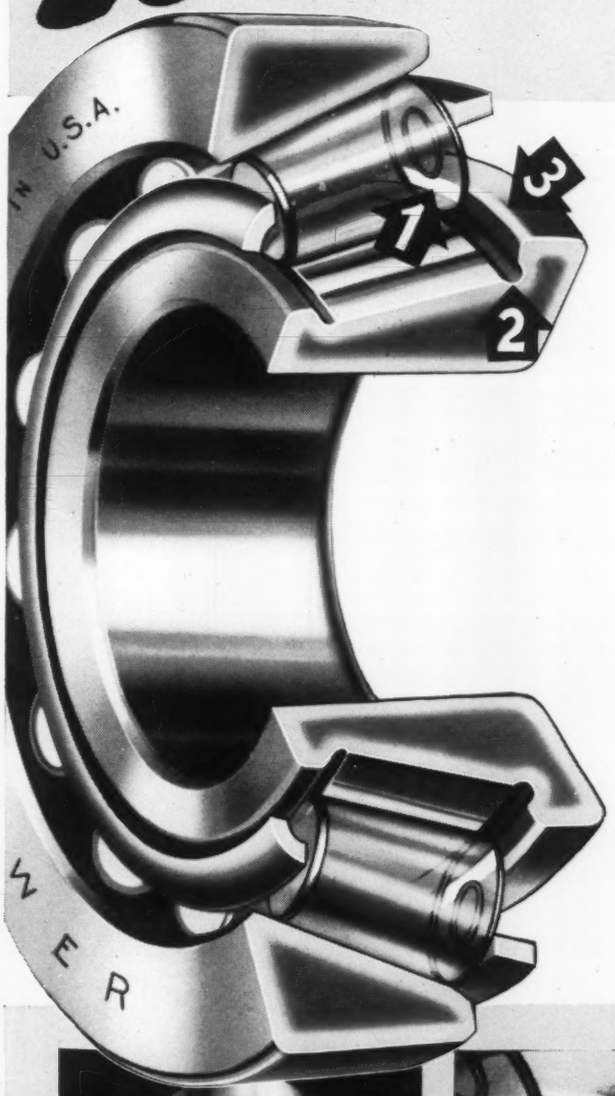
June 17—

American Society of Heating and Ventilating Engineers. Semiannual meeting to be held in Washington. A. V. Hutchinson, 51 Madison avenue, New York, is secretary.

June 17-20—

American Society of Agricultural Engineers. Annual meeting to be held at State College, Pa. Raymond Olney, St. Joseph, Mich., is secretary.

LOOK AT ALL 3



THERE are three points in Bower design that builders and users of bearing-equipped machinery can well afford to study.

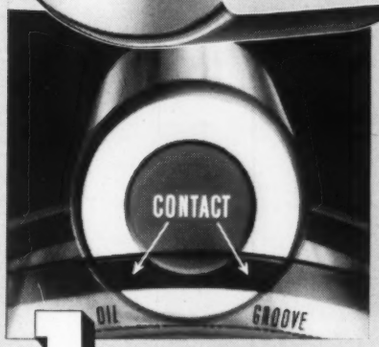
All three are features of flange design and all three are exclusive to Bower, particularly in the extent to which they carry advanced engineering and the degree in which they improve results in practical operation.

Working together, they strike at the most dangerous enemy of tapered roller bearing operation. —*wear-back* of roll heads. In so doing, they not only contribute tremendously to the life of the entire bearing, but also effectively solve the problem of adjustment.

It is now possible to permanently adjust a Bower Tapered Roller Bearing at the time of installation, so that wearing-in, running-in and "final adjustment" are entirely eliminated.

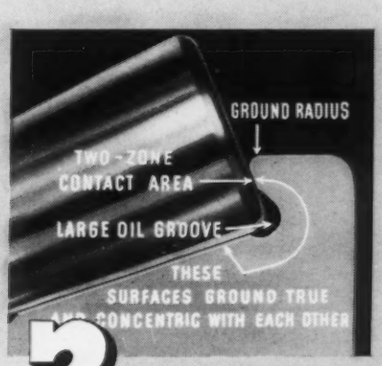
More detailed information is to be found in a folder, entitled "Secrets of Bower Design and Quality," which you may have on request.

BOWER
ROLLER BEARING CO.
Detroit, Michigan

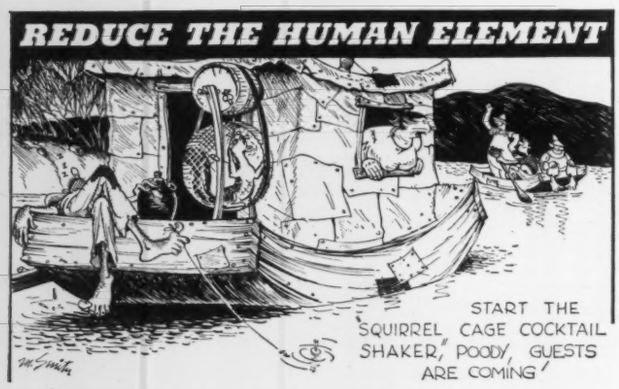


1 **TWO-ZONE CONTACT:** Provides wider base for squaring-up roll head, insuring rigid alignment. Gives larger area of contact surface, reducing wear by reducing unit pressure.

2 **LIBERAL OIL GROOVE:** Insures against excessive wear-back of roll head by supplying an abundant, constant supply of lubricant which the roll picks up as it turns.



3 **GROUND RADIUS:** Prevents chipping and noise by allowing roll head to enter smoothly into contact. Bower's special finish of bearing surfaces further prevents wear of parts.



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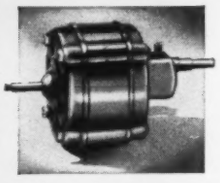

APPLICATIONS (Dizzy & Otherwise)
Animated signs, such as:
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4—Chamfered edge knurled to facilitate assembly.

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Nothing too large - Nothing too small for
SAFETY SOCKET SCREW CORPORATION
4447 N. KNOX AVE., CHICAGO, ILLINOIS

Photoelastic Analysis

(*Continued from Page* 53)

men). Retarding axis of the second plate will be vertical, cancelling the advance produced at the vertical axis of the first plate. As before, the ring may be rotated around disk to horizontal setting, placing pointer of this plate also on the advancing axis. This completes the adjustment of the polariscope.

The polariscope should be set up for use as follows: Swing quarter-wave plates out of position. Rotate index hand on the polarizer to the vertical (90 degree) position. "Tune" analyzer to maximum field darkness. Swing first quarter-wave plate into position and set on 45 degrees. Swing second quarter-wave plate into position and tune to maximum darkness. Instrument is then ready for use.

Setup Varies with Model

In commercial work it is only necessary to calibrate once for each Bakelite plate. The specimen just used to adjust the polariscope may be used for the first calibration. It will probably have dried out somewhat along the edges causing an edge pattern; however, since the stress along the centerline only is used, this will not matter. By increasing the load, the value that centers each succeeding dark fringe about the centerline should be noted. The average step per fringe exclusive of the first one may then be determined. This load per fringe, divided by the width and thickness of the specimen at the midpoint, will give the stress per fringe for material of this thickness. Multiplying this by the thickness gives the value for material 1 inch thick. This is the calibration value, noted as H. For Bakelite of the type previously described this is between 80 and 90 pounds per square inch per fringe per inch thickness. From this is obtained,

$$H = P/w \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (19)$$

where P is the total load per fringe, and w is the width. Note that the thickness of the specimen does not enter into the equation for H.

The setup and method of loading will vary with each model, and will frequently call for considerable ingenuity. A typical case of the writer's will be discussed in detail. *Fig.* 17 shows, in heavy lines, the model with the required loading. The hole at the load R was positioned by means of a steel bushing and small steel pin. (This arrangement keeps the friction at a minimum.) Force T was located in its line of action by another bushing with a piece of .02 inch diameter music wire looped through it.

Wire was clamped to lower cross bar in proper angular relation to the line connecting the two holes. The arrangement of these parts with some other details

"LOGAN" CHUCKS ARE DESIGNED AND BUILT FOR ACCURACY AND HEAVY DUTY

ONLY "LOGAN" American Standard Chucks have all of these features:

1. ONE-PIECE ELECTRIC STEEL BODY —Cored for light weight and radially reinforced for extra strength. No screws to work loose and impair chucking accuracy or operating efficiency.

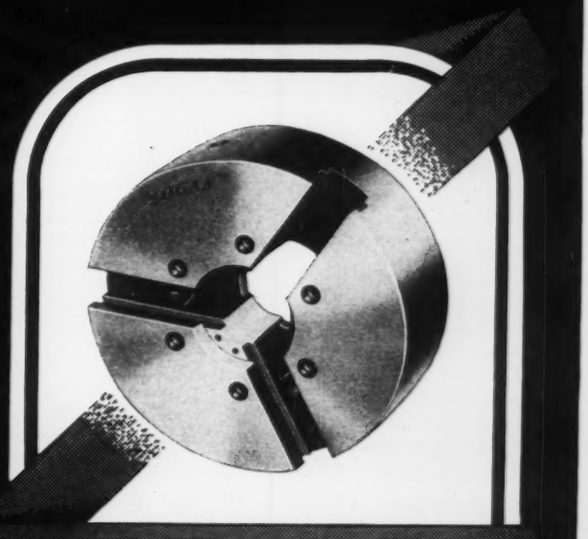
2. ALLOY STEEL INTERNAL WORKING PARTS—Heat treated for maximum strength. Extra large bearing surfaces to resist wear.

3. ALLOY STEEL MASTER JAWS — Hardened and ground. Cross jaw lock provides positive means for mounting false jaws.

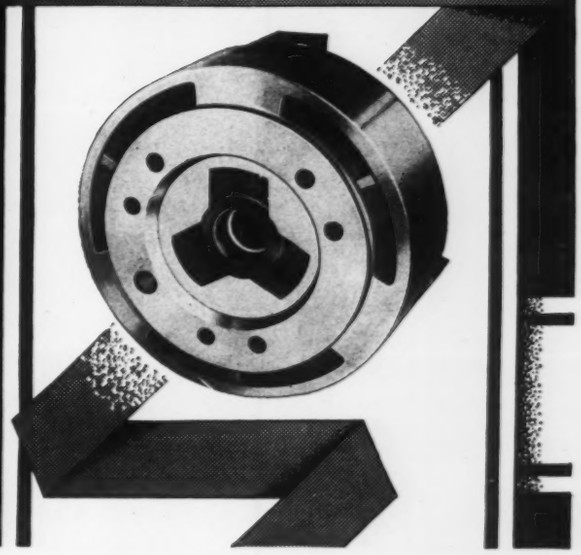
4. POSITIVE DUST-PROOF SEAL—Constant contact between master jaw and under side of pilot bushing support.

5. ALEMITE LUBRICATION — Provided to lubricate all working parts.

Specify "LOGAN" Chucks for superior performance and positive chucking accuracy. Write for complete Chuck Catalog.



ONE-PIECE STEEL BODY



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Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories

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***Dependable* PERFORMANCE**

★ Series 110-AC Relay by Guardian, illustrated, is a time-tested and proven control unit with a wide range of general applications. Simply constructed—compact—sensitive—quickly and steadily responsive with full wiping action of pure silver contacts—low-priced. These are the factors that assure dependable low-cost performance of Relays by Guardian.

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Designed singly, with hundreds of contact combinations available. Furnished in complete control assemblies from 3700 standard Guardian parts—synchronized each to the other and to your machine. High speed production lines turn out ANY QUANTITY AS YOU WANT THEM WHEN YOU WANT THEM—with a plant within a plant to produce those few control units you need at once.

Quantity orders produced in three days time—or faster with overnight shipments to every industrial center. Write

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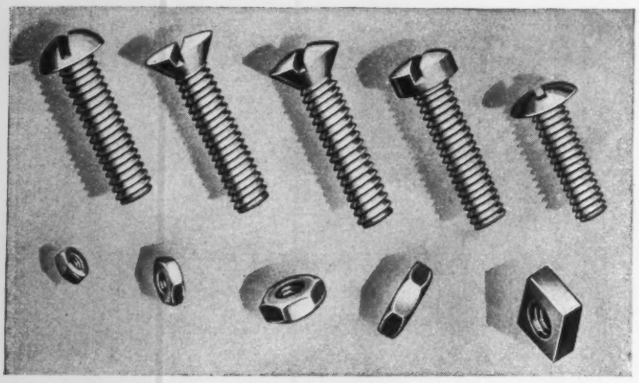

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★ Standard Machine Screws and Machine Screw Nuts, in steel and in brass, are carried in stock in enormous quantities at Central.

Famous for uniformity—ease of application and rigid holding power—they will speed your assemblies—improve your product—reduce your costs.

Same-day shipment to any industrial center, assured upon receipt of your order.

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are shown by the light dotted lines. The force P was applied over its required width of .07 inch by means of the ⅛-inch cold drawn hex. The piece of music wire here shown is looped through one of the ends of the spring balance previously described. Application of a given load at P will now develop definite reactions at R and T.

Loading directions may be checked by making a scale layout of the model with load lines of action shown, on tracing paper and holding against the model with the lamp lighted. Rotating one of the quarter-wave plates 90 degrees out of position will outline the model in a light field, and important small details, such as the exact position of the ⅛ inch hex, may be checked on the screen at large magnification.

By placing on top of the model a small piece of Bakelite with two scratches exactly ¼ inch apart, the magnification may be determined easily. Set up may be enlarged 5 to 10 diameters, permitting easy checking. A small load should be placed on the balance to eliminate shifting of the forces, and to draw the wires straight. Care must be observed to secure concentricity of the loads in order that plane stress may be obtained.

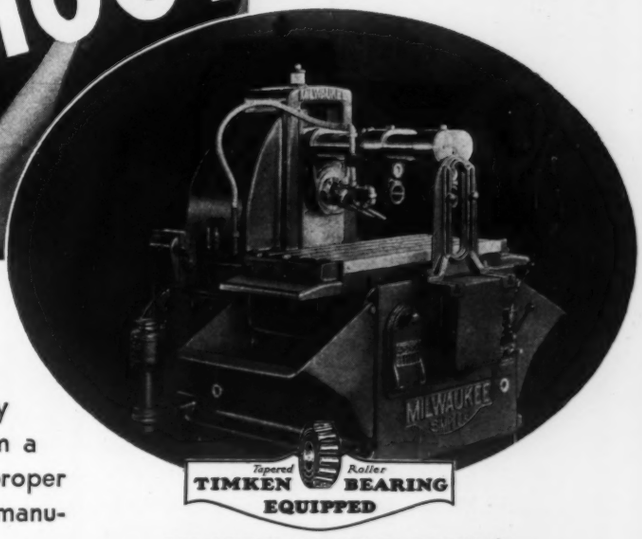
Pattern Usually Limited to Ten Fringes

Before attempting a determination, model should be gradually loaded so that the general pattern may be observed. Zero points, if any are present, may then be determined by noting those points which do not lighten, regardless of the load. Points of high stress along the boundary will be apparent, and their determination will give control points which will usually make possible the determination of every fringe desired. Checks should be made by counting to a number of points, and then releasing the load, counting the number of times that point lightens and darkens, that is, the number of fringes that pass over it. The points of high concentration along the boundary should be rechecked by reloading and unloading. Pattern should be limited to 8 or 8½ fringes until the operator becomes skilled, when 10 or 10½ (for ¼ inch thick material) may be set as the safe limit.

It may be found that fringe details at points of high concentration will disappear with higher loads. The alignment of model and all parts of the polariscope should be checked carefully with the optical axis. Then if refocusing does not help, the trouble is probably in the polishing. In repolishing, the polishing scratches should run at right angles to the fringes the detail of which is desired. Polishing should be done with a cloth freshly cleaned by holding a small scrubbing brush against the wheel, flushing off freely with clean water. A few drops of the levigated alumina should be applied, polishing for 15 to 20 seconds on each side with a very light pressure. Then the model is flushed clear in clean water and wiped

Below: Kearney & Trecker Series 1200 and 1800 Milwaukee Milling Machines equipped with 26 TIMKEN Bearings for utmost operating smoothness and accuracy. TIMKEN Bearings are used on the spindle, speed change gear mechanism, quick-change feed box, pick-off feed box, spindle reverse gear bracket, table, pulley drive bracket and lubricating pump.

THAT'S SMOOTHNESS!



"Smooth as a baby's cheek" might well describe the performance of TIMKEN Tapered Roller Bearings and the equipment in which they are used. Such smoothness only can come from a combination of scientifically correct design, proper material of the highest quality and extreme manufacturing precision.

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THE SYMBOL FOR MILES OF SMILES

TIMKEN
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Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Notably reduces power loss . . .

T-J

HYDRAULIC CYLINDER PISTONS are SEALED with PACKINGS

On test these cylinders show a 95% average efficiency for pressures from 500 to 2000 pounds per square inch. This applies to "blank" end pressures, that is, the "push" stroke of the cylinder. "Rod" end pressure stroke efficiency is from two to three points lower (because of the added sealing friction of the piston rod packings), but only until the pressure reaches 1000 pounds per square inch where the 95% efficiency is attained.

Catalog H-37 reports on additional construction features, service characteristics and gives complete cylinder specifications. Your copy (which also includes important usable data on hydraulic installations) will be sent promptly. Address The Tomkins-Johnson Co., 618 N. Mechanic Street, Jackson, Michigan.

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to combat . . .

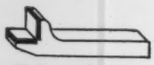
EXCESSIVE ABRASIVE ACTION IN YOUR MACHINE

Specify KENNAMETAL

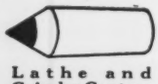
ON PARTS SUBJECT TO WEAR

A piece of KENNAMETAL no larger than a thumb tack may save your customers thousands of dollars in replacement costs for worn out parts. For KENNAMETAL is the hardest metal made by man, being next to the diamond in hardness . . . a small insert at the point of wear will increase the life of the part from 10 to 25 times. KENNAMETAL blanks are supplied in practically any shape desired for brazing on parts subject to wear . . . or we can furnish you with completely finished parts to assemble in your machine. McKenna engineers will gladly work with you in utilizing KENNAMETAL to best advantage in your machine design.

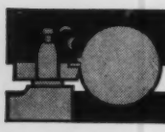
Cut out view of typical KENNAMETAL work support.



Follow Rests



Lathe and Grinder Centers



McKENNA METALS Co.

146 LLOYD AVENUE

LATROBE, PENNSYLVANIA, U.S.A.

gently with cleaning tissue. Fingers should not be permitted to contact the detail desired. It will generally be found, if care is used in refocusing, alignment of apparatus, etc., that the finest detail can be brought out.

Fig. 18 is an unretouched photo of the fringe pattern of the section noted in *Fig.* 17. The narrow fringes are but little more than .001 inch wide. The lines at right angles to the fringes are polishing scratches. The heavy, nearly horizontal line across the piece is the .02 inch music wire through which the load was applied. With a little practice, detail as fine as this may easily be obtained.

One of the great values of this method of analysis lies in the use of successive models. After a contour which is sure to give permissible stresses is determined, a model of this contour may be made and analyzed. Then material may be removed at desirable points, the model analyzed at successive stages until the stress reaches the limit. In this way the minimum possible section may be obtained. In making comparisons it is generally best to work to a definite fringe value, comparing the loads required to obtain this value. Greater accuracy may be obtained by using a half fringe, splitting the light band with the edge of the model. The center may be estimated by noting the width of the adjacent band. If the outline is not clear one of the quarter-wave plates may be rotated a few degrees out of position, which will lighten somewhat the background without materially affecting the results.

Photographs Permit Rechecking

Since it is easy to make mistakes in reading directly from the screen, particularly in the case of a complicated pattern, it is strongly recommended that a photograph always be made. The permanent record, permitting rechecking at latter dates, will be found invaluable. Four by five inches is a satisfactory size from the standpoint of economy and coverage. An orthochromatic film, having a Weston rating in artificial light of 20, has a good response to the greenish yellow light. A fine grain developer similar to Eastman D-76 is recommended. With this film and developer, and a light of the same intensity as the writer's, the exposure will be in seconds equal to the square of the diameter of enlargement divided by eight. It is not critical—the time may be cut in half, or doubled, without materially affecting the results. Gloss paper is satisfactory for contact prints, velvet texture being preferred for enlargements because of ease of writing on its surface. No special technique is required for enlarging. Magnification may be indicated by including in the photo a piece the size of which is known, or placing on the model the marked piece of Bakelite previously described.

(CONTINUED IN NEXT ISSUE)

The Point to Remember

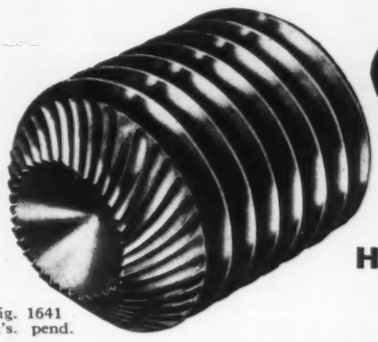


Fig. 1641
pat's. pend.

UNBRAKO

SELF-LOCKING
HOLLOW SET SCREWS
with the Knurled Points

FOR INSURING TROUBLE-FREE OPERATION OF THE MACHINES YOU DESIGN

"Unbrako" Self-Lockers insure protection that means savings in maintenance . . . protection that insures savings in maintenance dollars, freedom from accidents and breakdowns. For once set up with no more than ordinary pressure, these screws automatically lock into place with a grip that just can't let go no matter how bad the vibration. Yet adjustment is easy, and "Unbrako" Self-Locking Hollow Set Screws can be re-used indefinitely—always with the same dependable effectiveness.

Such unfailing advantages can't help but provide trouble-free operation where ordinary set screws may not be reliable. It pays to play safe by specifying "Unbrako" Self-Lockers.

KNURLED

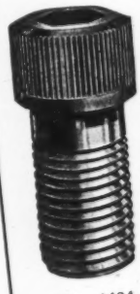


Fig. 1434
Pat's. Pend.

UNBRAKO

SOCKET HEAD
CAP SCREWS

for strength and accuracy

Fig. 1446
Knurled
Socket Head
Stripper Bolt

Up-to-date alloys, heat treated for maximum toughness . . . micrometric machining . . . careful inspection—these are your assurance of absolute uniformity of fit and dependable strength. Knurled "Better-Grip" Heads prevent finger slip, speed up production, permit greater compactness of flange design. Look into these too . . .

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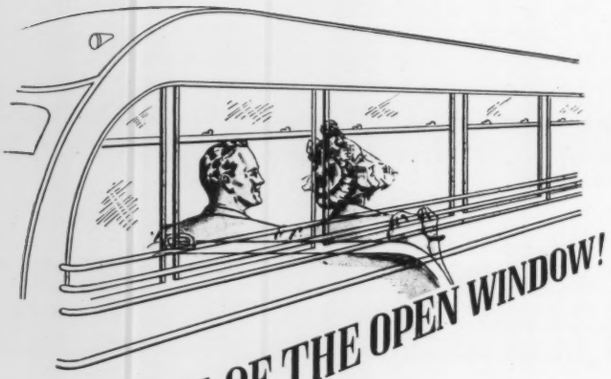

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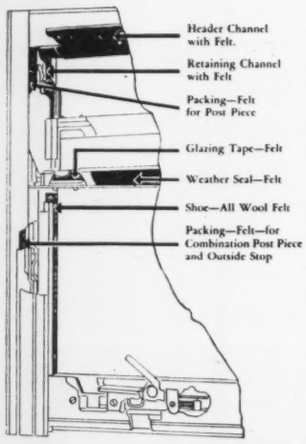

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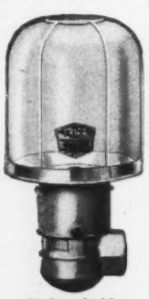

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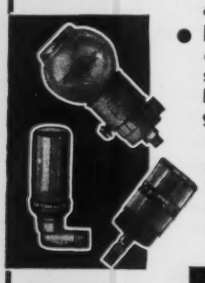

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TRICO FUSE MFG. CO., Milwaukee, Wis.
In Canada: IRVING SMITH LIMITED, Montreal

Notches Affect Springs

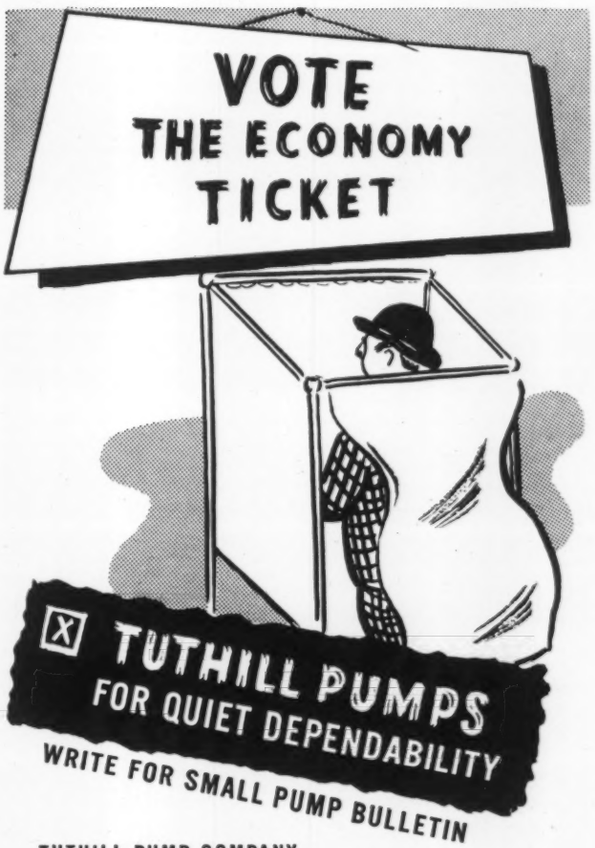
(*Concluded from Page* 43)

r/h approaches unity. The importance of avoiding sharp bends in such springs is obvious.

In the application of flat springs it is frequently desirable to clamp the ends as indicated in *Fig.* 10, which represents a simple cantilever spring. Because of the clamping pressure a certain amount of stress concentration exists at A under fatigue loading. This will result in a reduction of fatigue strength below that obtained when the spring is tested in the form shown by the dotted line *b, Fig.* 10, which practically eliminates stress concentration. In addition under repeated loading there is also a certain amount of rubbing at the clamped edges, point A, which results in the so-called rubbing corrosion or brown rust. This latter results in a further lowering of the fatigue strength which may be particularly great for the higher strength materials.

Although there appears to be little data available on the subject, particularly as applied to spring steels, some results of fatigue tests were published by Hankins[6]. These tests were made on flat specimens of leaf spring steel, ⅜-inch thick, with the surface left untouched after heat treatment, the loading conditions being essentially those of *Fig.* 10. When the specimens were clamped and of uniform width the endurance limit in completely reversed bending stress for a .48 per cent carbon steel was $\pm$ 33,600 pounds per square inch, while tests on the specimens without stress concentration, *b, Fig.* 10, showed a value of $\pm$ 47,000 pounds per square inch, the fatigue strength reduction factor K_f in this case being therefore 47,000/33,600 = 1.4. Similar tests on a .6 per cent carbon spring steel showed a reduction in endurance limit from 60,500 to 45,000 pounds per square inch and a factor K_f = 1.35. No data were given as to the actual clamping pressures in these tests. It should be noted that for higher strength materials, where the surface has been ground after heat treatment, much larger values than these are quite possible. For example, in bearing fits where a similar condition exists, values of K_f as high as 3 to 4 are found for alloy steel shafts.

Stress concentration effects which may occur in flat springs under repeated loading due to holes, notches, sharp bends, and clamped edges may be taken into account by the methods outlined herein. Since the theoretical stress concentration factors given may be somewhat above the actual fatigue factors, due to "size effect" etc., in general the results obtained by using these methods will be on the safe side, particularly for very thin springs, assuming that no corrosion exists. Where springs are under a purely static load, or if the load is repeated but a few times, it is suggested that stress concentration effects may be neglected.



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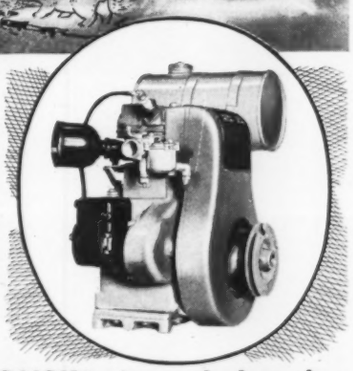

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There is a WISCONSIN air-cooled engine to power any job—12 sizes—1 to 35 H.P.

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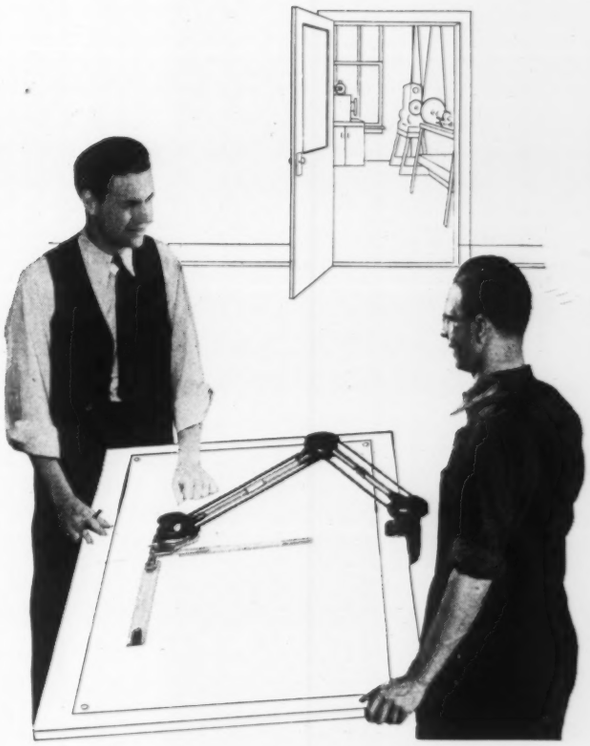

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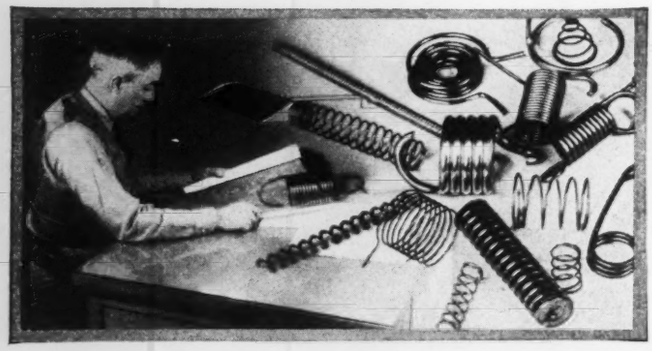

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AND SCREW MACHINE PARTS

The Peck Spring Co. **10 Wells St., Plainville, Conn.**

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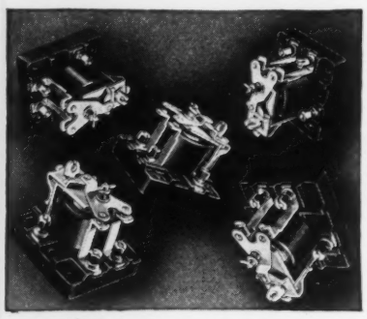

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ELECTRIC CONTROL DEVICES SINCE 1892.

Business and Sales Briefs

RESIGNATION of W. L. Kelly as vice president and country sales manager of Chicago Molded Products Corp., Chicago, has been announced. E. C. Maywald, executive vice president of the company, will continue in charge of all sales activities.

♦

Appointment of the Industrial Supply Co., 537 South Seventh street, Minneapolis, as distributor has been made by Ohio Gear Co., Cleveland. The new distributor will carry a complete stock of standard gears, covering Minnesota and the Northwest territory.

♦

The largest increase in licensees for any similar period except that immediately following the organization of New Wrinkle Inc. has been announced by the company. The new licensees are: American Lacquer Solvents Co., Phoenixville, Pa.; Yarnall Paint Co., Philadelphia; New England Lacquer Co., Providence, R. I.; The Boydell Bros. White Lead & Color Co., Detroit; V.E.P. Co., Detroit; Leon Finch Ltd., Los Angeles; American Asphalt Paint Co., Chicago; Louisville Varnish Co., Louisville, Ky.; and Fulghum & Co., Los Angeles.

♦

E. F. Meyer, who has been with Cutler-Hammer Inc. since leaving school, has been placed in charge of the company's Houston territory, with headquarters in that city.

♦

Formerly assistant director of technical service on mill products in New York, for International Nickel Co. Inc., F. L. LaQue is now engaged in development activities on all applications of both ferrous and nonferrous nickel-containing alloys. Dr. William A. Mudge, who recently joined the technical service section of the development and research division, will assist Mr. LaQue as assistant director.

♦

The ninth sales office to be established by the plastic department of General Electric Co. has been opened in Rochester, N. Y., under the direction of A. G. Davidson Jr. as sales representative. The plastic molding plants are in Pittsfield, Mass., and in Meriden, Conn.; and the laminating plant in Lynn, Mass. In addition to the sales office mentioned above, others are located in Fort Wayne, Ind., Chicago, New York, Philadelphia, Meriden, Detroit, Cleveland and Lynn, Mass.

♦

Exhibit of machines and processes which was held by Ozalid Corp. at the New York World's Fair last year will be shown at the New York offices of the company located at 354 Fourth avenue. Visitors are invited.

♦

Construction is scheduled to start at once of a large rolling mill at Midland, Mich., by The Dow Chemical Co. It is planned to increase the production of Dowmetal in sheet form at least 50 per cent by the installation of complete rolling mill equipment and a four-high rolling mill in addition to the present equip-

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FOR LESS THAN 1¢ PER SQUARE FOOT

REMARKABLE NEW *Simplex* BLUEPRINTER CUTS COST, SAVES TIME — NO EXPENSIVE EQUIPMENT. NO EXPERIENCE NECESSARY! • ACT NOW!

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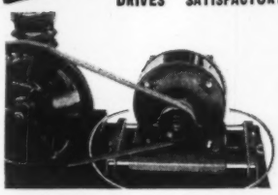
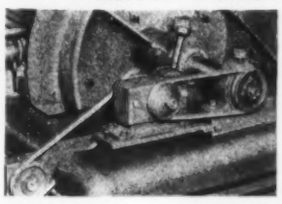


Priced right down to rock bottom. *Ideal* "Automatics" are a sure-fire talking point to boost sales of new equipment. Springs maintain correct belt tension on any type of belt drive under any type of load up to 15 H.P.

FEATURES: Improves Machine Performance; Decreases Belt, Bearing and Machine Wear; Practical for Even the Lowest Priced Equipment; Increases Customer Satisfaction.

IDEAL "SELECT-O-SPEED" Transmission

Low Cost Variable Speed Transmission. Gives Your Machines A New, Powerful Selling Argument.



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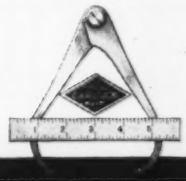
Garlock now manufactures a line of Metric O.D. KLOZURES to fit into the same housing bore that receives ball and and roller bearings made to Metric O.D.'s Metric O.D. KLOZURES frequently save machining and tooling costs; also cut down installation time. Write for further details.



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Every foot of space at Kropp Forge is utilized to render maximum service for our customers; the entire organization being keyed to meet your most exacting forging needs. No demands for steam hammer, drop or upset forgings, however unusual, can throw us into a panic.

Production short cuts based on 100 years of forging experience enable us to do the seemingly impossible with speed, the economies effected being passed along to the customer.

Next time save money, time and patience — try Kropp — the World's Largest Job Forging Shop — for your forgings.

KROPP FORGE COMPANY
World's Largest Job Forging Shop
5307 W. Roosevelt Road, Chicago
Representatives in Principal Cities

OHMITE
Has the Resistors you need!

YES . . . like so many other important product designers and manufacturers—you can solve your resistor problem quickly, economically, dependably—just by asking Ohmite! Very often you'll find exactly what you need in the wide range of Ohmite stock types, sizes and ratings —the largest stock of wire-wound vitreous-enameled resistors available anywhere. Or, Ohmite Engineers, with their specialized experience will gladly work out the best, most economical units for your specific need.

Write Today for Catalog 17

OHMITE MANUFACTURING COMPANY
4831 FLOURNOY STREET ★ CHICAGO, ILLINOIS, U. S. A.

Be Right with OHMITE
RHEOSTATS • RESISTORS • TAP SWITCHES

ment. The new plant will be ready for operation some time during the summer.

♦

Associated with The Timken Roller Bearing Co., since 1919 in various positions, and more recently in managerial capacities on the West Coast, Yale D. Hills has been appointed assistant general manager of the service-sales division. His position before his present advancement was that of supervisor of distributors.

♦

Janette Mfg. Co., Chicago, has appointed A. R. Niemoeller as its sales and service representative in the St. Louis territory. Mr. Niemoeller's headquarters are at 5817 Itaska street.

♦

Since 1932 general sales manager of The Reliance Electric & Engineering Co., Cleveland, James W. Corey has been elected sales vice president. Beginning in the engineering department, Mr. Corey has served as a member of the sales department, assistant sales manager, general sales manager and director of the company.

♦

To represent the Ampco Metals Inc., Milwaukee, in the Pittsburgh district, R. H. Munn has been appointed sales representative. Mr. Munn has had industrial experience and metallurgical training, and is well-qualified to discuss bronze alloy application problems with manufacturers.

♦

For several years advertising manager of Libbey-Owens-Ford Glass Co., North A. Wright has been named general sales promotion manager, and will head a new division designed to consolidate and increase various sales promotion activities.

♦

Purchase of the Great Lakes Forge Co., Chicago, has been made by The American Brake Shoe & Foundry Co. The Great Lakes plant operates board and steam hammer equipment, varying in weight from 1200 to 10,000 pounds falling weight. The plant has ample die making capacity and a modern heat-treating department. G. C. Hodgson, president of the Great Lakes company, is retiring from active business. The new president will be W. E. Crocombe, and H. Mulford vice president in charge of sales.

♦

According to a recent announcement by H. G. Batcheller, president, Allegheny Ludlum Steel Corp., Col. James G. Cowling has been made special representative in the company's relations with the federal government agencies. His office is located at 1001 Fifteenth street, Washington.

♦

Charles S. Harper Jr. and J. A. Denholm Jr. have been made members of the Eastern sales organization, with headquarters in New York, of The Dayton Rubber Mfg. Co. Mr. Harper, because of past sales engineering experience, is ably fitted for sales engineering work on industrial V-belts, and will represent the company in metropolitan New Jersey and lower New York state area. A graduate of Harvard Engineering School, Mr. Denholm was formerly connected with The Carrier Corp. for twelve years, in the capacities of research engineer, general purchasing agent, as well as assistant of construction work. He will work directly out of the New York office.

Good reasons for a good name

You who depend on hollow screws to "hold things together,"—you depend on tests so long as *you* do the testing. Beyond that, you depend on the good name of the screws.

For a good name, you know, is established not by any test or series of tests, but by meeting the tests of practical *use* under all shop conditions, over a long term of years. Yes, 30 years in the case of your ALLENS!

From its very first year, Allen *Cold-Drawing* produced screws that tested 30% stronger than hollow screws made by other processes. And by supplementing this cold-drawing process by cold-extrusion or *"Pressur-Forming"* of Cap Screws, we've added to Allens' original strength through

—making the steel-fibers conform to the contour of the screw head;

—preserving *continuous* steel-fibers from end to end of the screw;

—turning the fiber-ends *in* toward the socket-hole, to more solidly resist wrench-pressure.

Your local Allen Distributor provides prompt, accommodating service.

THE ALLEN MANUFACTURING COMPANY
HARTFORD, CONNECTICUT, U. S. A.

1939
INDEX

Copies of the editorial contents index for 1939 issues still are available. These will be sent to readers at no cost but only upon request.

Indexes for the years 1936, 1937 and 1938 also are available without cost to readers as long as the limited supply lasts.

Address your letter to Circulation Dept.:

MACHINE DESIGN
Penton Building Cleveland, Ohio

10 or 10 thousand
Precision Production Makes Every One Uniform and Dependable

Uniform quality in Briggs & Stratton motors is positive because production is held to precision standards—in the most complete plant—fully "tooled up" for the manufacture of small gasoline motors. . . All material—all parts—are subjected to many exacting inspections ending with a severe running test of each complete motor . . . Ten or ten thousand—you know you will get uniformly dependable performance from every Briggs & Stratton gasoline motor. A full range of sizes from ½ to 5 HP.

BRIGGS & STRATTON CORP.
Dept. MD-5, Milwaukee, Wis.

NEW MACHINES—
And the Companies Behind Them

(For ilustrations of other outstanding machinery see Pages 58-59)

Bakery

Rotary pie machine, Colborne Mfg. Co., Chicago.
Dough room air conditioning unit, Bahnson Co., Winston-Salem, N. C.
*Dough divider, The Century Machine Co., Cincinnati.

Brewery

Beverage bottling machine, Lynch-Alcop Corp., Anderson, Ind.

Construction

Heavy-duty loader, George Haiss Mfg. Co. Inc., New York.
Tunnel muck loaders, Eimco Corp., Salt Lake City, Utah.
Shovel-dragline-crane, Link-Belt Speeder Corp., Chicago.

Dairy

Can washer, Oakes & Burger Co. Inc., Cattaraugus, N. Y.
Two-quart bottle washers, The Heil Co., Milwaukee.

Dental

Dental X-ray, H. G. Fischer & Co., Chicago.

Domestic

Electric broiler, International Appliance Corp., Brooklyn.
Cordless electric iron, Ark Mfg. Co., Philadelphia.
Vegetable liquidizer, Knapp Monarch Co., St. Louis.
Stoker, Stoker Div., Link-Belt Co., Chicago.
Portable recorder, Bell Sound Systems Inc., Columbus, O.
Electric fan, The Emerson Electric & Mfg. Co., St. Louis.
Console and window type room coolers, General Electric Co., Schenectady.
Firetenders, Holcomb & Hoke Mfg. Co., Indianapolis.
Plastic bathroom scale, The Brearley Co., Rockford, Ill.

Die Casting

Hydraulic die casting machine, G & M Mfg. Co., Cleveland.

Electrical

*Diesel electric generator unit, Lister-Blackstone Inc., Milwaukee.

*Illustrated in pictorial center spread, Pages 58-59.

Diesel electric sets, Caterpillar Tractor Co., Peoria, Ill.

Finishing

Portable electric sander, Detroit Surfacing Machine Co., Detroit.
Wire plating machine, Munning & Munning Inc., Newark, N. J.

Food

Fruit syrup mixer, L. O. Koven & Brother Inc., Jersey City, N. J.
Ice cream freezer, Refrig-O Co., Pittsburgh.

Forging

*Forging machine, Ajax Mfg. Co., Cleveland.
Pneumatic hammer, Chambersburg Engineering Co., Chambersburg, Pa.

Industrial

Slasher-exhauster, L. J. Wing Mfg. Co., New York.
Ventilating fan, B. F. Sturtevant Co., Hyde Park, Boston.
Oil burners, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Portable fans, Truflo Fan Co., Harmony, Pa.
Electric hoists, Shaw Box Crane & Hoist Div., Manning, Maxwell & Moore Inc., Muskegon, Mich.
Floor machine, Regina Corp., Rahway, N. J.

Inspection

*Visual inspection X-ray unit, General Electric X-ray Corp., Chicago.

Pumping

*Power pack unit, Wallace Supplies Mfg. Co., Chicago.
Deep well water systems, Turbine Pump Div., Roots Connersville Blower Corp., Connersville, Ind.
Slush pump, Gardner-Denver Co., Quincy, Ill.
*Meter Pump, Erie Meter Systems Inc., Erie, Pa.

Refrigerating

Dry storage type coolers, Frigidaire Div., General Motors Sales Corp., Dayton.
*Refrigerator, Philco Radio & Television Co.

Tobacco

*Cigar making machine, International Cigar Machinery Co., Brooklyn.

Woodworking

*Double planer, Baxter D. Whitney & Son Inc., Winchendon, Mass.
*Plow-bore, Wilkin-Challoner Co., Oshkosh, Wis.
*Plywood or veneer machine, Adamson Machine Co., Akron, O.

at HOWELL-
And factory gets your motors out on time.
Designers adapt your needs to production.
Engineers furnish complete data promptly.
A Howell Field Man will call on you at once.
This is the new HOWELL Type K totally-enclosed, fan-cooled motor.
Note STREAM-LINED housing which adds smart appearance to internal quality.
You Get FAST ACTION
All Down the Line—
Even on SPECIAL Motors
In developing and producing SPECIAL motors, there are no bottlenecks at HOWELL.
While we can't anticipate your special requirements by having the motors you need in stock, we DO maintain a service which wastes no time either in engineering or manufacturing.
And because we handle a tremendous volume of special motors annually, HOWELL field men and the factory have a wealth of experience from which you can profit.
Consult HOWELL first for FAST ACTION—for intelligent action that saves time and money.
HOWELL builds motors ½ to 150 HP.—open-frame, totally-enclosed, fan-cooled, splash-proof and explosion-proof types—adapted electrically and mechanically to any drive problem—for vertical mounting, with special end plates, special bases, etc.—also in all multi-speed combinations.
1915 • 1940
HOWELL
MOTORS
25th Anniversary Year
HOWELL ELECTRIC MOTORS COMPANY
HOWELL, MICHIGAN
Representatives In All Principal Cities

WHERE DO I GO FROM HERE?

SEND for one of these couplings and test it yourself—as many others have. They absorb torsional vibration and accommodate both angular and parallel misalignment. They prevent the telegraphing of motor hum, gear noise, etc. along the shaft, making for quiet installations. They are easy to install and handle, being compact units without loose parts. They are rugged—out of thousands now in service only five have been returned because of failure.

LORD FRACTIONAL H.P. COUPLINGS CAN TAKE IT.

FOR EXAMPLE: (a) During a test for bond strength, coupling J-1211-1 was twisted 710° before failure. At rated h. p. and r.p.m. twist is only 20°.

(b) For a hurried approval test on coupling J-1211-3, one customer ran 8000 stops and starts followed by a week's run ⅛ inches out of line, all under extremely adverse operating conditions. No failure was noted—the coupling was approved.

Write for Bulletin 200.

LORD MANUFACTURING CO., Erie, Pennsylvania

BRANCH OFFICES
923 Fairmount Rd.
Burbank, Calif.

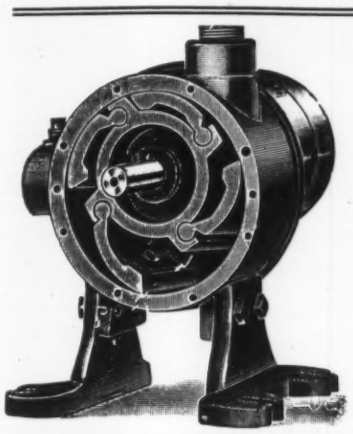
BONDED RUBBER JOINTS

LORD
BONDED RUBBER

SHEAR TYPE RUBBER MOUNTINGS

280 Madison Ave.
New York City
332 S. Michigan Ave.
Chicago, Ill.

It takes rubber in shear to absorb vibration



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Rotary Positive
AIR PUMPS
for pressure, vacuum and gas pumping.
AIR MOTORS
They take up their own wear

Standard Equipment on all sorts of Air Using Devices and used by the world's leaders . . . . .

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Standard Oil Co., New York
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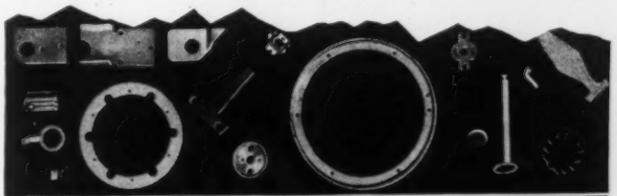
ALL KINDS UP TO 15" X 15" X ⅛"



HUNTER PRESSED STEEL COMPANY
LANSDALE, PENNSYLVANIA